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Practice Guideline for Arterial Blood Gas Measurement in the Intensive Care Unit Decreases Numbers and Increases Appropriateness of Tests (Clinical Investigation)—Pilon CS, Leathley M, London R, McLean S, Phang PT, Priestley R, et al. Crit Care Med 1997;25(8):1308-1313.

Correlation between Simple Clinical Parameters and the In Vitro Humidification Characteristics of Filter Heat and Moisture Exchangers (Clinical Investigation)—Beydon L, Tong D, Jackson N, Dreyfuss D, and the Groupe de Travail sur les Respirateurs. Chest 1997;112(3):739-744. **Is a Nose Just a Nose? (Editorial)**—Branson RD. Chest 1997;112(3):581.

The Clinician's Perspective on Pneumothorax Management (Special Report)—Baumann MH, Strange C. Chest 1997;112(3):822-828.

Breastfeeding and the Use of Human Milk (Statement from the American Academy of Pediatrics)—Gartner LM, Black LS, Eaton AP, Lawrence RA, Naylor AJ, Neifert ME, et al, for the Workgroup on Breastfeeding. Pediatrics 1997;100(6):1035-1039.

Fourth Edition of the Guidelines for Perinatal Care: Summary of Changes—Oh W, Merenstein G. Pediatrics 1997;100(6):1012-1022.

Assessment of Asthma Using Automated and Full-Text Medical Records—Donahue JG, Weiss ST, Goetsch MA, Livingston JM, Greineder DK, Platt R. J Asthma 1997;34(4):273.

Automated medical records systems are used to study clinical outcomes and quality of care, but this requires accurate disease identification and assessment of severity. We sought to determine the reliability of identifying asthmatics through automated medical and pharmacy records, and the adequacy of such data for severity assessment. All adult health maintenance organization (HMO) members who received at least 1 asthma drug and an asthma diagnosis between April 1988 and September 1991 were identified. Records of a random sample were reviewed to validate the diagnosis and extract clinical information. Asthma drugs were dispensed to 15,491 individuals; 7583 (49%) also received an asthma diagnosis. Asthma drug use was 3 times greater for persons with diagnosed asthma compared to those with no diagnosis. Record review revealed that a coded asthma diagnosis had a positive predictive value of 86%. Nearly 4000 ambulatory encounters were reviewed, 10% of which were for asthma; the median number of encounters was 2. Asthma symptoms were mentioned in 9% of all encounters; wheezing was most common. Peak flow and spirometry were measured in 4% and 1% of encounters, respectively. Records from recipients of asthma drugs who lacked an asthma diagnosis showed that 79% did not have asthma. Automated medical and pharmacy records from an HMO were relatively accurate when used to identify individuals with asthma. Similarly, most asthma drug recipients who lacked a coded diagnosis of asthma did not have asthma. However, conventional full-text records usually do not contain sufficient information to assess asthma severity, limiting the utility of such records for research and quality improvement.

Effect of Theophylline on Erythrocytosis in Chronic Obstructive Pulmonary Disease—Oren R, Beeri M, Hubert A, Kramer MR, Matzner Y. Arch Intern Med 1997;157(13):1474.

BACKGROUND: Patients with chronic obstructive pulmonary disease (COPD) tend to develop secondary erythrocytosis to compensate for their chronic hypoxia. Theophylline has recently been shown to reduce hematocrit and erythropoietin blood levels in normal subjects and in patients with erythrocytosis after renal transplantation. OBJECTIVE: To determine whether theophylline may be used to lower the hematocrit in patients with COPD. METHODS: Two-hundred four patients with COPD were studied retrospectively and 10 patients prospectively (8 starting treatment with the drug [Group 1] and 2 who suspended its long-term use [Group 2]) for the correlation between theophylline therapy and hematocrit and erythropoietin level. RESULTS: In the patients studied retrospectively, lower hematocrits were found in the theophylline-treated than in the untreated patients (0.43 ± 0.006 vs 0.46 ± 0.007, respectively; $p < 0.002$). Twelve untreated patients and 2 of those treated with theophylline had hematocrits above 52%. Oxygen saturation levels were similar in both groups, and exclusion of patients with oxygen saturation lower than 88% did not change the pattern, suggesting that the effect of theophylline could not be entirely explained by improved oxygen availability. Seven of the 8 patients studied prospectively in Group 1 ($p < 0.02$) and the 2 patients in Group 2 showed inverse correlations between hematocrits and theophylline administration. A similar pattern was observed with serum erythropoietin levels in 5 of 7 patients studied. The effects were reproducible on rechallenge in 3 of the 4 patients in Group 1 and the 2 patients in Group 2. CONCLUSIONS: Theophylline may have a beneficial effect in treatment and prevention of erythrocytosis in patients with COPD.

Acute Respiratory Distress Syndrome in a Community Hospital ICU—Nolan S, Burgess K, Hopper L, Braude S. Intensive Care Med 1997;23(5):530.

OBJECTIVE: To estimate the incidence of the acute respiratory distress syndrome (ARDS) in an Australian urban community, and to describe the pattern of disease and outcomes in a community hospital intensive care unit (ICU). SETTING: An 8-bed general ICU in a community hospital. DESIGN: Retrospective chart review. PATIENTS: 32 patients identified over a 4-year period as having ARDS. MEASUREMENTS AND RESULTS: The incidence of ARDS in an Australian urban community was estimated to be 7.3-9.3 cases/100,000 population/year. In-hospital mor-

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tality was 59%, while ICU mortality was 47%. Sepsis, pneumonia, and aspiration were the main aetiological factors accounting for 94% of the patient population. There was no trauma. The Acute Physiology and Chronic Health Evaluation and Murray scores and values for the ratio of the partial pressure of oxygen in arterial blood and fractional inspired oxygen on admission to the ICU were similar between survivors and nonsurvivors, and none of these parameters were reliable predictors of outcome. Mean age, however, was different between survivors (56 ± 16 yrs) and nonsurvivors (69 ± 9 yrs) ($p \leq 0.01$). Mean daily fluid balance was also different between survivors (536 ± 545 mL/day) and nonsurvivors (1576 ± 1255 mL/day) ($p \leq 0.02$). Haemodynamic data were collected on 21 of the 32 patients within 72 hours of the onset of ARDS. None of the haemodynamic parameters reached significance. There was, however, a trend for better cardiac function and oxygen consumption in the survivors. CONCLUSIONS: These data show that for ARDS, at least, mortality outcome can be comparable in a community ICU to a tertiary referral institution. The pattern of disease in an urban Australian community hospital is different to that often reported from tertiary centres. The incidence of ARDS in an Australian urban community is comparable to the reported incidence in North America and Western Europe.

Breathing Pattern and Additional Work of Breathing in Spontaneously Breathing Patients with Different Ventilatory Demands during Inspiratory Pressure Support and Automatic Tube Compensation—Fabry B, Haberthur C, Zappe D, Guttmann J, Kuhlen R, Stocker R. Intensive Care Med 1997;23(5):545.

OBJECTIVE: We designed a new ventilatory mode to support spontaneously breathing, intubated patients and to improve weaning from mechanical ventilation. This mode, named Automatic Tube Compensation (ATC), compensates for the flow-dependent pressure drop across the endotracheal tube (ETT) and controls tracheal pressure to a constant value. In this study, we compared ATC with conventional patient-triggered inspiratory pressure support (IPS). DESIGN: A prospective, interventional study. SETTING: A medical intensive care unit (ICU) and an ICU for heart and thoracic surgery in a university hospital. PATIENTS: We investigated 2 groups of intubated, spontaneously breathing patients: 10 postoperative patients without lung injury, who had a normal minute ventilation ($\dot{V}_E$) of 7.6 ± 1.7 l/min, and 6 critically ill patients who showed increased ventilatory demand ($\dot{V}_E = 16.8 \pm 3.0$ l/min). INTERVENTIONS: We measured the breathing pattern [$\dot{V}_E$], tidal volume (V_T), and respiratory rate (RR)] and additional work of breathing (WOB_{add}) due to ETT resistance and demand valve resistance. Measurements were performed under IPS of 5, 10, and 15 mbar and under ATC. RESULTS: The response of V_T, RR, and WOB_{add} to different ventilatory modes was different in both patient groups, whereas $\dot{V}_E$ remained unchanged. In postoperative patients, ATC, IPS of 10 mbar, and IPS of 15 mbar were sufficient to compensate for WOB_{add}. In contrast, WOB_{add} under IPS was greatly increased in patients with increased ventilatory demand, and only ATC was able to compensate for WOB_{add}. CONCLUSIONS: The breathing pattern response to IPS and ATC is different in patients with differing ventilatory demand. ATC, in contrast to IPS, is a suitable mode to compensate for WOB_{add} in patients with increased ventilatory demand. When WOB_{add} was avoided using ATC, the patients did not need additional pressure support.

Comparison of Three Oxygen Delivery Systems during Exercise in Hypoxemic Patients with Chronic Obstructive Pulmonary Disease—Hagarty EM, Skorodin MS, Langbein WE, Hultman CI, Jessen JA, Maki KC. Am J Respir Crit Care Med 1997;155(3):893.

Oxygen therapy improves submaximal exercise tolerance in hypoxemic patients with chronic obstructive pulmonary disease (COPD). This study compared the standard nasal cannula, reservoir nasal cannula, and a demand flow device in 15 male hypoxemic patients with COPD. On 6 separate occasions each subject used, in a randomized order, all 3 systems while completing incremental cycle ergometry and a test circuit composed of tasks that simulate activities of daily living. Oxygen flow required during exercise was 1.8 ± 0.9 and 2.8 ± 0.7 L/min for reservoir nasal cannula and standard nasal cannula use, respectively ($p < 0.0001$). The effect of the 3 oxygen delivery systems on oxygen saturation (S_{pO_2}) during the last 30 seconds of exercise varied with type of activity. Only during demand flow device use while undressing and dressing was the subjects' S_{pO_2} (90 ± 3%) significantly lower ($p = 0.019$). There was a trend toward lower S_{pO_2} with the demand flow device ($p = 0.103$) during arm work above shoulder level. Although not statistically significant, reservoir nasal cannula use resulted in consistently lower tidal volume and minute ventilation during test circuit activities. Exercise tolerance was not significantly different between the 3 oxygen delivery systems.

Pathophysiologic Basis of Acute Respiratory Distress in Patients Who Fail a Trial of Weaning from Mechanical Ventilation—Jubran A, Tobin MJ. Am J Respir Crit Care Med 1997; 155(3):906.

To determine the mechanisms of acute respiratory distress and failure in patients with chronic obstructive pulmonary disease (COPD), we studied 17 ventilator-supported patients who failed a trial of spontaneous breathing and 14 patients who tolerated such a trial and were successfully extubated. Immediately before the weaning trials, maximal inspiratory pressure was not statistically different between the 2 groups ($p = 0.48$). On discontinuation of the ventilator, the failure group immediately developed rapid shallow breathing, and higher values of dynamic lung elastance (E_{dynL}) ($p < 0.01$) and intrinsic positive end-expiratory pressure ($PEEP_i$, $p < 0.03$) than did the success group. Between the onset and end of the trial, the failure group developed further increases in E_{dynL} ($p < 0.0001$) and $PEEP_i$ ($p < 0.0001$), and increases in inspiratory resistance ($p < 0.009$) and inspiratory pressure-time product (PTP) ($p < 0.0001$). Partitioning of PTP at the end of the trial revealed a 111% increase in the $PEEP_i$ component, a 33% increase in the non-$PEEP_i$ elastic component, and a 42% increase in the resistive component (all $p < 0.0001$). Despite the increase in PTP, 13 of the failure patients developed an increase in P_{aCO_2}. The product of PTP and P_{aCO_2}, an index of inefficient CO_2 clearance, was more than twice as high in the failure group than in the success group at the end of the trial ($p < 0.0005$). Thus, development of acute respiratory distress during a failed weaning attempt was due to worsening of pulmonary mechanics, which in conjunction with rapid shallow breathing led to inefficient clearance of CO_2.

Passive Mechanics of Lung and Chest Wall in Patients Who Failed or Succeeded in Trials of Weaning—Jubran A, Tobin MJ. Am J Respir Crit Care Med 1997;155(3):916.

In an accompanying article (Jubran et al, Am J Respir Crit Care Med 1997;155:906-915), we report that patients with chronic obstructive pulmonary disease (COPD) who failed a trial of weaning from mechanical ventilation developed worsening of pulmonary mechanics compared with patients who tolerated the trial and were extubated. We wondered whether the greater derangements in pulmonary mechanics in the weaning failure patients are evident ever before undertaking the weaning trial. We measured mechanics of the respiratory system, lung, and chest wall during passive ventilation at usual ventilator settings in 12 patients who went on to fail a weaning trial and in 12 patients who were successfully weaned. No differences in the resistances of the respiratory system, lung, and chest wall were observed between the two groups or when the resistances were separated into the components derived from ohmic resistance and viscoelastic behavior/time-constant inhomogeneities. Likewise, the groups did not differ in terms of static elastance and dynamic intrinsic positive end-expiratory pressure ($PEEP_i$) of the respiratory system and the respective lung and chest wall components or in terms of dynamic elastances of the respiratory system and chest wall. The failure group had a higher dynamic elastance of the lung than the success group ($p < 0.01$), but the individual values showed considerable overlap among the patients in the 2 groups so limiting its usefulness in signaling a patient's ability to sustain spontaneous ventilation. Thus, mechanics of the respiratory system and its lung and chest wall components during passive ventilation did not satisfactorily discriminate between patients who failed a weaning trial and those successfully weaned, and, thus, are unlikely to be useful in signaling a patient's ability to tolerate the discontinuation of mechanical ventilation.

Outcomes of Advance Directive Education of Pulmonary Rehabilitation Patients—Heffner JE, Fahy B, Hilling L, Barbieri C. Am J Respir Crit Care Med 1997;155(3):1055.

We performed a 2-site prospective, controlled interventional study of patients enrolled in pulmonary rehabilitation to assess effects of advance directive education on completion of (1) living wills, (2) durable powers of attorney for health care (DPAHC), (3) patient-physician discussions about advance directives, and (4) discussions about life support, in addition to (5) patient impressions that their physicians understood their end-of-life preferences. The educational group had an increase ($p < 0.05$) in all 5 study outcomes compared with baseline values; the control group had an increase in 3 of 5 outcomes. The effect strength was greater in the educational compared with the control group for completion of DPAHC (odds ratio [OR] = 3.6, 95% confidence interval [CI] 1.1 to 12.9), advance directive discussions (OR = 2.9, 95% CI 1.1 to 8.3), initiation of life-support discussions (OR = 2.7, 95% CI 1.0 to 7.7), and development of patient assurance that their physicians understand their preferences (OR = 3.7, 95% CI 1.3 to 13.4). The educational intervention was an independent explanatory factor by multivariate analysis. We conclude that patients enrolled in pulmonary rehabilitation are receptive to advance care planning, which is promoted by education on end-of-life issues.

A Trial of Antioxidants N-Acetylcysteine and Procysteine in ARDS. The Antioxidant in ARDS Study Group—Bernard GR, Wheeler AP, Arons MM, Morris PE, Paz HL, Russell JA, Wright PE. Chest 1997;112(1):164.

OBJECTIVE: To determine the levels of glutathione and cysteine in patients with ARDS and examine the effect of treatment with N-acetylcysteine (NAC) and L-2-oxothiazolidine-4-carboxylate (Procysteine; Clintec Technologies Inc; Chicago [OTZ]) on these levels and on common physiologic abnormalities and organ dysfunction associated with ARDS. DESIGN: Randomized, double-blind, placebo-controlled, prospective clinical trial. SETTING: ICUs in 5 clinical centers in the United States and Canada. PATIENTS: Patients meeting a predetermined definition of ARDS and requiring mechanical ventilation. INTERVENTION: Standard care for ARDS and I.V. infusion, every 8 hours for 10 days, of one of the following: NAC (70 mg/kg, n = 14), OTZ (63 mg/kg, n = 17), or placebo (n = 15). MAIN RESULTS: Both antioxidants effectively repleted RBC glutathione gradually over the 10-day treatment period (47% and 49% increases from baseline values for NAC and OTZ, respectively). There was no difference in mortality among groups (placebo, 40%; NAC, 36%; OTZ, 35%). However, the number of days of acute lung injury was decreased and there was also a significant increase in cardiac index in both treatment groups (NAC/OTZ [+]14%; placebo [−]6%). CONCLUSIONS: Our findings suggest that repletion of glutathione may safely be accomplished with NAC or OTZ in patients with acute lung injury/ARDS. Such treatment may shorten the duration of acute lung injury, but larger studies are needed to confirm this.

Severe Paroxysmal Sinus Bradycardia Associated with High-Frequency Oscillatory Ventilation—Mellema JD, Baden HP, Martin LD, Bratton SL. Chest 1997;112(1):181.

OBJECTIVE: To determine the incidence of and risk factors for unexplained paroxysmal bradycardia in children treated with high-frequency oscillatory ventilation (HFOV). DESIGN: A nested case-control study. SETTING: A university-affiliated children's hospital. SUBJECTS: All children treated with HFOV for at least 3 days during a 2-year period and a randomly chosen comparison group of 50 children treated with only conventional mechanical ventilation (CMV) for at least 3 days during the same time period. INTERVENTIONS: None. MEASUREMENTS & RESULTS: Unexplained paroxysmal sinus bradycardia occurred in 6 children (12%) receiving HFOV and was significantly more common than in children treated with CMV (0%). The bradycardic events occurred after the lung disease started to improve, and the mean airway pressure ($\overline{P}_{aw}$) at the time of the bradycardias was significantly decreased from the child's maximal $\overline{P}_{aw}$. The bradycardic events were effectively treated acutely with manual ventilation or atropine sulfate, and resolved completely after the patient was changed to a regimen of CMV. CONCLUSION: Unexplained paroxysmal bradycardia associated with HFOV in children is not uncommon. It completely resolves with conversion to CMV and may be related to overdistention of alveoli as compliance improves.

Effect of Failed Extubation on the Outcome of Mechanical Ventilation—Epstein SK, Ciubotaru RL, Wong JB. Chest 1997;112(1):186.

OBJECTIVE: To examine medical outcomes associated with reintubation for extubation failure after discontinuation of mechanical ventilation. DESIGN: Prospective cohort study of consecutive intubated medical ICU patients who underwent a trial of extubation at a tertiary-care teaching hospital. The failed extubation group consisted of all patients reintubated within 72 hours or within 7 days (if continuous ICU care had been required) of extubation. All others were considered to be successfully extubated. Study end points included hospital death versus survival, the number of days spent in the ICU and in the hospital after the onset of mechanical ventilation, the likelihood of requiring ≥7 or ≥14 days of ICU care after extubation, and the need for transfer to either a long-term care or rehabilitation facility among the survivors. RESULTS: Of 289 intubated patients, 247 (85%) were successfully extubated, and 42 (15%) required reintubation for failed extubation (time to reintubation 1.5 ± 0.2 days). Reintubation for extubation failure resulted in 12 additional days of mechanical ventilation. When compared with successfully extubated patients, reintubated patients were more likely to die in the hospital (43% vs 12%; $p < 0.0001$), spend more time in the ICU (21.2 ± 2.8 days vs 4.5 ± 0.6 days; $p < 0.001$) and in the hospital (30.5 ± 3.3 days vs 16.3 ± 1.2 days; $p < 0.001$) after extubation, and require transfer to a long-term care or rehabilitation facility (38% vs 21%; $p < 0.05$). Using multiple logistic regression, extubation failure was an independent predictor for death and the need for transfer to a long-term care facility. Compared with those successfully extubated, patients who failed extubation were 7 times ($p < 0.0001$) more likely to die, 31 times ($p < 0.0001$) more likely to spend g14 days in the ICU after extubation, and 6 times ($p < 0.001$) more likely to need transfer to a long-term care or rehabilitation facility if they survived. CONCLUSION: After adjusting for severity of illness and comorbid conditions, extubation failure had a significant independent association with increased risk for death, prolonged ICU stay, and transfer to a long-term care or rehabilitation facility. Extubation failure may serve as an additional independent marker of severity of illness. Alternatively, poor outcomes may be etiologically related to extubation failure. If the latter proves to be the case, identifying patients at risk for poor outcomes from extubation failure and instituting alternative care practices may reduce mortality, duration of ICU stay, and need for transfer to a long-term care facility.

Early vs Conventional Extubation after Cardiac Surgery with Cardiopulmonary Bypass—Reyes A, Vega G, Blancas R, Morato B, Moreno JL, Torrecilla C, Cereijo E. Chest 1997;112(1):193.

OBJECTIVES: Sedation and ventilation overnight after cardiac surgery is common practice. However, early extubation may be feasible with no increase in postoperative complications. This study examines (1) if early extubation is possible in a significant number of patients, (2) if it reduces ICU stay, and (3) if this practice increases postoperative complications. DESIGN: Prospective, controlled, randomized clinical trial. PATIENTS & METHODS: We randomized 404 consecutive

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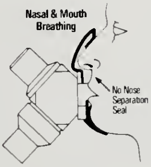

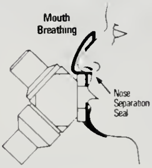

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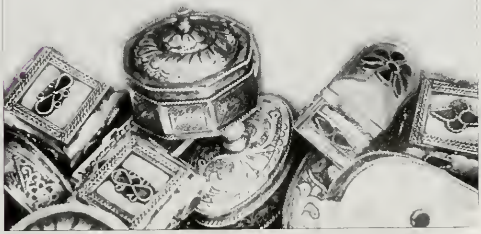

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patients to early extubation (7 to 11 hours postoperatively) (Group A, 201 patients) or conventional extubation (between 8 and 12 AM the following day) (Group B, 203 patients). Variables included type and severity of the disease, surgical risk, type of operation, operative incidences, postoperative complications, duration of mechanical ventilation, intubation and ICU stay, bleeding, reoperation, vasoactive drugs, and mortality. RESULTS: Groups were comparable. Extubation within the preestablished time was successful in 60.2% of patients in Group A and 74.4% in Group B. Median ICU stay was 27 hours in Group A and 44 hours in Group B ($p = 0.008$). Discharge from ICU within the first 24 hours postoperatively was 44.3% in Group A and 30.5% in Group B ($p = 0.006$). There was no significant difference in complications between groups. Successfully extubated patients in Group A had more reintubation and prolonged ventilation than in Group B. CONCLUSIONS: (1) Sixty percent of our patients were extubated within 11 hours of operation. (2) As a result, the length of stay in ICU was reduced and the percentage of patients discharged within 24 hours was increased. (3) There was no increase in clinically important postoperative complications.

Noninvasive Positive Pressure Ventilation and Not Oxygen May Prevent Overt Ventilatory Failure in Patients with Chest Wall Diseases—Masa JF, Celli BR, Riesco JA, Sanchez de Cos J, Disdier C, Sojo A. Chest 1997;112(1):207.

Some patients with chest wall diseases (CWD) without respiratory failure manifest important alterations in nocturnal gas exchange, as a previous stage to the future development of daytime respiratory failure. The purpose of this study was to evaluate the efficacy of nasal intermittent positive pressure ventilation (NIPPV) during sleep in a group of obese patients and in another group with restrictive thoracic diseases (RTD), comparing the results with those obtained from conventional nocturnal oxygen therapy. From a total of 42 patients with CWD free of daytime respiratory failure, 27 (64%) were considered nocturnal oxygen desaturators without sleep apnea and were included in the study. The study protocol was completed by 21 of these patients. After 2 weeks of treatment, symptoms of dyspnea, morning headaches, and morning obnubilation improved significantly ($p < 0.05$) in both groups of patients after NIPPV but not with oxygen. Baseline daytime P_{aO_2} was 68 ± 7 mm Hg in the obese group of patients and 73 ± 11 mm Hg in the RTD group. It improved significantly with NIPPV to 73 ± 5 mm Hg in obese patients ($p < 0.05$) and to 77 ± 12 mm Hg in the RTD group ($p < 0.05$) but did not change with oxygen (68 ± 8 mm Hg in the obese group and 73 ± 12 mm Hg in the RTD group). Both treatments improved oxygen saturation during sleep, but oxygenation tends to be higher with oxygen than with NIPPV. Only NIPPV was able to normalize the baseline nocturnal alveolar hypoventilation. From the 21 patients treated, 19 decided to continue with long-term NIPPV, 1 with oxygen, and 1 refused treatment. We conclude that in patients with CWD who manifest nighttime oxygen desaturation and hypoventilation, early initiation of NIPPV is preferable to supplemental oxygen. Our results also suggest that NIPPV initiated before overt ventilatory failure could prevent its onset.

Measurements of PEEP-Induced Changes in Lung Volume: Evaluation of a Laser Monitor—Uhlig T, Kondo T, Sly PD. Chest 1997; 112(1):107.

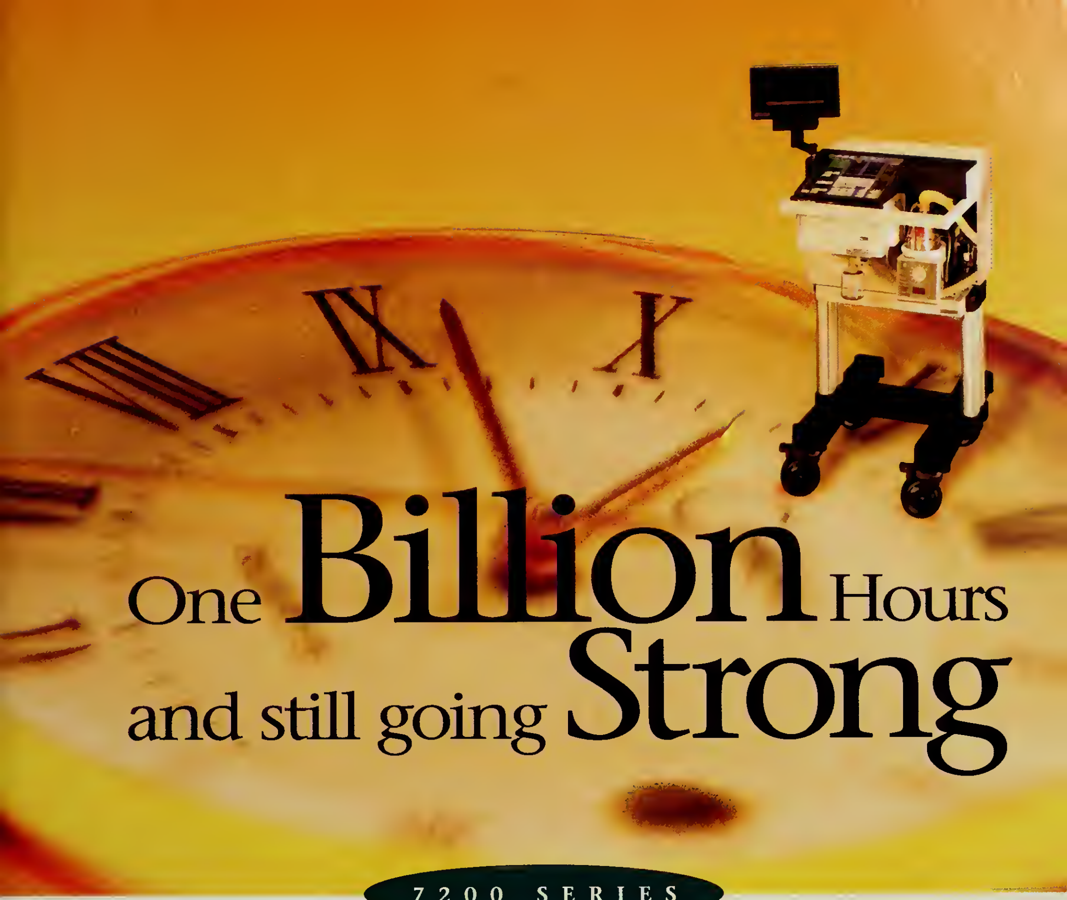
STUDY OBJECTIVE: To evaluate a newly developed laser monitor in the measurement of positive end-expiratory pressure (PEEP)-induced changes in end-expiratory lung volume (EELV) in spontaneously breathing subjects. DESIGN: An open comparison between 2 different methods to assess breathing parameters. SETTING: A respiratory research unit. PARTICIPANTS: Six spontaneously breathing, healthy volunteers. INTERVENTIONS: Stepwise increases of PEEP from 0 to 0.8 to 1.6 kPa during spontaneous breathing; repeated validation of the laser monitor in each subject. MEASUREMENTS & RESULTS: Pressure and flow were recorded at the airway opening. Abdominal wall displacement (AWD) measured by the laser sensor was recorded simultaneously. The time lag between the volume and the laser signals during baseline was 0.068 ± 0.052 seconds and during maximal PEEP, 0.108 ± 0.093 seconds. There was no baseline drift in either the PEEP or the AWD signals. Mean EELV decreased by 290 mL to 1,157 mL after the PEEP valve was removed. Within each individual, the ratio between EELV and AWD showed only small variations. Measurements of tidal volume (V_T) and AWD showed good agreement at all PEEP levels. Mean V_T decreased in all but 1 subject during PEEP. With the increase in PEEP, the end-expiratory abdominal baseline increased linearly over a large range of end-expiratory pressures with a flattening of the curve at high PEEP levels in all subjects. CONCLUSIONS: The laser monitor is sufficiently accurate for measuring PEEP-induced changes in EELV during spontaneous breathing in healthy adult subjects. Monitors incorporating multiple laser sensors may have considerable clinical promise.

Patient Preferences for Communication with Physicians about End-of-Life Decisions. SUPPORT Investigators. Study To Understand Prognoses and Preference for Outcomes and Risks of Treatment—Hofmann JC, Wenger NS, Davis RB, Teno J, Connors AF Jr, Desbiens N, et al. Ann Intern Med 1997;127(1):1.

BACKGROUND: Physicians are frequently unaware of patient preferences for end-of-life care. Identifying and exploring barriers to patient-physician communication about end-of-life issues may help guide physicians and their patients toward more effective discussions. OBJECTIVE: To examine correlates and associated outcomes of patient communication and patient preferences for communication with physicians about cardiopulmonary resuscitation and prolonged mechanical ventilation. DESIGN: Prospective cohort study. SETTING: Five tertiary care hospitals. PATIENTS: 1832 (85%) of 2162 eligible patients completed interviews. MEASUREMENTS: Surveys of patient characteristics and preferences for end-of-life care; perceptions of prognosis, decision making, and quality of life; and patient preferences for communication with physicians about end-of-life decisions. RESULTS: Fewer than one fourth (23%) of seriously ill patients had discussed preferences for cardiopulmonary resuscitation with their physicians. Of patients who had not discussed their preferences for resuscitation, 58% were not interested in doing so. Of patients who had not discussed and did not want to discuss their preferences, 25% did not want resuscitation. In multivariable analyses, patient factors independently associated with not wanting to discuss preferences for cardiopulmonary resuscitation included being of an ethnicity other than black (adjusted odds ratio [OR], 1.48 [95% CI, 1.10 to 1.99), not having an advance directive (OR, 1.35 [CI, 1.04 to 1.76]), estimating an excellent prognosis (OR, 1.72 [CI, 1.32 to 2.59]), reporting fair to excellent quality of life (OR, 1.36 [CI, 1.05 to 1.76]), and not desiring active involvement in medical decisions (OR, 1.33 [CI, 1.07 to 1.65]). Factors independently associated with wanting to discuss preferences for resuscitation but not doing so included being black (OR, 1.53 [CI, 1.11 to 2.11]) and being younger (OR, 1.14/10-year interval younger [CI, 1.04 to 1.25]). CONCLUSIONS: Among seriously ill hospitalized adults, communication about preferences for cardiopulmonary resuscitation is uncommon. A majority of patients who have not discussed preferences for end-of-life care do not want to do so. For patients who do not want to discuss their preferences, as well as patients with an unmet need for such discussions, failure to discuss preferences for cardiopulmonary resuscitation and mechanical ventilation may result in unwanted interventions.

Factors Influencing Termination of Resuscitative Efforts in Children: A Comparison of Pediatric Emergency Medicine and Adult Emergency Medicine Physicians—Scribano PV, Baker MD, Ludwig S. Pediatr Emerg Care 1997; 13(5):320-324

OBJECTIVES: To examine factors that influence termination of resuscitative efforts (TORE) and compare pediatric emergency medicine (PEM) and general emergency medicine (GEM) physicians regarding TORE in children. DESIGN: Cross-sectional survey. PARTICIPANTS: All physicians board-certified in PEM as of November 1993 and a random sample of board-certified GEM physicians listed in the 1993 American College of Emer-



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gency Physicians directory. INTERVENTIONS: Self-administered questionnaires were mailed to participants who were asked about experience providing pediatric cardiopulmonary resuscitation (CPR) and demographic information. We posed a series of management questions eliciting factors that influence TORE decision-making in single context and case scenario format. Specific emphasis was placed on the influence of time and epinephrine dosing. RESULTS: One hundred sixty (70%) PEM and 127 (62%) GEM responded. These groups differed significantly in years of experience (PEM 8.2, GEM 11.8), urban practice setting (PEM 84%, GEM 32%) and number of pediatric cardiopulmonary resuscitations per year (PEM 10.6, GEM 4.8), $p < 0.001$ for all. There were no significant differences between groups regarding features pathognomonic of death. PEM were more likely to consider low blood pH and iatrogenic causes of arrest as factors influencing TORE; GEM were more likely to consider co-morbid conditions ($p < 0.05$ for all). Medians for time estimates of minimum minutes of pulselessness that influence TORE were: PEM 26 to 30 min, GEM 31 to 35 min for both prehospital and emergency department settings ($p < 0.05$ for each). Approximately 20% of all respondents did not place a strict limit on time of pulselessness when determining TORE. No difference was observed between groups regarding maximum doses of epinephrine used prior to TORE. However, fewer GEM (50%) than PEM (75%) utilize "high dose" epinephrine according to current Pediatric Advanced Life Support (PALS) guidelines ($p < 0.05$). PEM physicians were more than 2 times more likely to terminate resuscitative efforts if return of spontaneous circulation was not achieved by 25 min compared to GEM physicians for both prehospital time of pulselessness [odds ratio 2.1, 95% confidence interval (1.01, 4.5)] and emergency department time of pulselessness [odds ratio 2.2, confidence interval (1.1, 4.6)]. CONCLUSIONS: (1) Several laboratory and clinical factors significantly influence physician's decisions regarding TORE; (2) regardless of setting, time of pulselessness does appear to be an influential factor in determining when to terminate resuscitation in children for most physicians; (3) PEM physicians are more likely to terminate resuscitative efforts than are GEM physicians if return of spontaneous circulation is not achieved by 25 min; (4) a significant number of PEM and GEM physicians do not use high-dose epinephrine in accordance with current PALS recommendations.

Comparison of Self-Inflating Bags with Anesthesia Bags for Bag-Mask Ventilation in the Pediatric Emergency Department—Mondolfi AA, Grenier BM, Thompson JE, Bachur RG. Pediatr Emerg Care 1997;13(5):312-316.

OBJECTIVE: To compare bag-mask ventilation performed by emergency department (ED) personnel using anesthesia bags (AB) and self-inflating bags (SIB). SETTING: ED in a teaching children's hospital where the AB is the device used during resuscitations. DESIGN: Experimental study. Bag-mask ventilation was evaluated with an infant resuscitation mannequin equipped to measure airway volumes and pressures. Pediatric residents, ED nurses, and pediatric emergency medicine fellows performed bag-mask ventilation with AB and SIB and rated their confidence using each device. MAIN OUTCOME MEASURE: Ventilation failure rates. RESULTS: Seventy subjects participated (17 interns, 16 junior residents, 13 senior residents, 10 fellows, and 14 nurses). There were 13 failures with the AB (18.6%) versus 1 (1.4%) with the SIB ($p < 0.01$) [95% confidence interval: 5-29%], with a significant difference even after excluding the least experienced subjects. There was no difference in high pressure breaths delivered (SIB 19% vs AB 15%, $p = 0.4$) and a higher incidence of hyperventilation with the SIB (67 vs 25%, $p < 0.01$). While using the SIB, 19 (27%) of the subjects did not turn on the O_2 flow. There was no difference in pretest confidence rating, but the post-test confidence rating was higher for the SIB ($p < 0.05$). CONCLUSIONS: Compared to SIB use for bag-mask ventilation in an ED, AB use resulted in more ventilation failures, no advantage in preventing excessive airway pressures, and less confidence among operators. The SIB should be the first choice for bag-mask ventilation in the ED, with attention to maximize oxygen delivery.

The Number of Stenotic Coronary Arteries and Passive Smoking Exposure from Husband in Life-Long Non-Smoking Women in Xi'an, China—He Y, Lam TH, Li LS, Li LS, Du RY, Jia GL, et al. Atherosclerosis 1996;127(2):229-238.

The relationship between the number of stenotic coronary arteries and passive smoking exposure from the husband was examined in a retrospective study of 78 cases with stenotic coronary arteries and 83 controls with normal coronary arteries. All the 161 subjects were examined by coronary arteriography and were Chinese women who had never smoked cigarettes (i.e. life-long nonsmokers). The Pearson's and Spearman's correlation coefficients between the number of stenotic coronary arteries and passive smoking exposure indices were 0.27-0.29 and 0.25-0.28 (all with $p < 0.01$), respectively. The linear prediction equations from multiple regression analysis showed that passive smoking exposure, after adjustment for other major risk factors, was a significant predictive variable for the number of stenotic coronary arteries. The multiple response logistic regression model was used to estimate the odds ratio of stenotic coronary arteries for passive smoking exposure categories. The crude and adjusted odds ratios showed that the number of stenotic arteries increased with the amount of exposure to passive smoking from the husband. These results provide new evidence to support that passive smoking is causally associated with coronary heart disease.

Taking the Cure to the Poor: Patients' Responses to New York City's Tuberculosis Program, 1894 to 1918—Abel EK. Am J Public Health 1997;87 (11):1808-1815.

Drawing on the case files of a major charitable agency, this paper explores how poor people experienced New York City's pioneering program of tuberculosis control. Although the program provided enormous benefits, poor New Yorkers often had pressing concerns that took priority over eradicating tuberculosis. Moreover, the program imposed extreme hardships even as it promised liberation from a terrible scourge. Poor people did not protest collectively, but many individually resisted. They delayed seeking diagnosis, disobeyed the advice promulgated by the Department of Health, attended clinics irregularly, and either refused to enroll in hospitals, sanatoria, and preventoria or fled soon after arrival.

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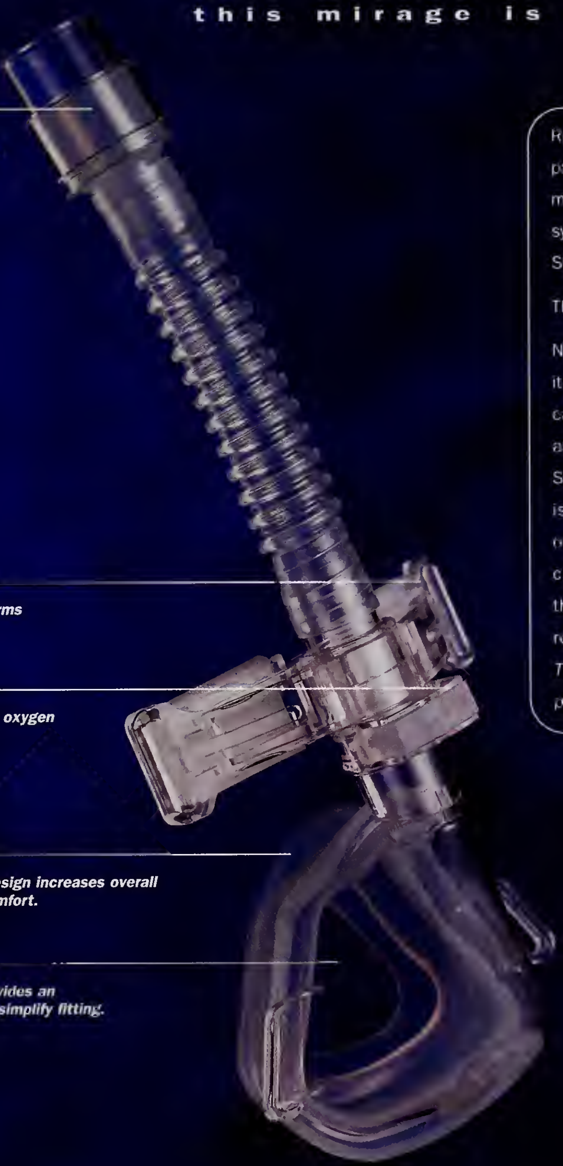

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- Reporting of Competence Patterns and Trends
- Integration of Competency Assessments with In-Services and Continuing Education
- System for Linkage of Job Description, Competency Level, Annual Performance Evaluation, and Performance Improvement
- Appendix–Self-Learning Module for Critical Organizational System Safety Practices
- Appendix–Orientation and Competency Validation for Multi-Skilling and Cross-Training in Perinatal Care
- Appendix–Sample Performance Evaluation Instrument

By Daniel Grady, MEd, RRT; Valerie Lawrence, RRT; Tammy Caliri, RRT; and Mitzi Johnson, RNC, MSN. 258 Pages, Binder. 1997

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What Is Respiratory Care?

This issue of RESPIRATORY CARE begins the first new volume after a change in editorship. It ushers in a new, expanded Editorial Board and other changes as well, some of which are described in the accompanying editorial by Assistant Editor Kris Williams. It thus seems appropriate to review the mission and goals of RESPIRATORY CARE, the Journal, in the context of respiratory care, the profession, and respiratory care, the subject area within health care.

Respiratory Care, The Profession

According to the American Association for Respiratory Care (AARC), respiratory care is "a health care specialty under medical direction in the assessment, treatment, management, control, diagnostic evaluation, and care of patients with deficiencies and abnormalities of the cardiopulmonary system."[1] The AARC further defines this health care specialty as follows:[2]

> Respiratory care is a life-supporting, life-enhancing health care profession practiced under qualified medical direction. Respiratory care services provided to patients with disorders of the cardiopulmonary system include: diagnostic testing, therapeutics, monitoring, and rehabilitation. Patient, family, and public education are central to the mission of the profession. Respiratory care services are provided in all health care facilities and in the home.

Thus, respiratory care the profession is distinct from physical therapy, nursing, and other health care professions, and respiratory care practitioners (RCPs) are not physical therapists, nurses, or physicians. By current estimates, there are about 100,000 RCPs in the United States. Their professional association, the AARC, has approximately 38,000 members and in 1996 celebrated the 50th anniversary of its founding. Through the National Board for Respiratory Care, RCPs can be credentialed either as Registered Respiratory Therapists (RRTs) or Certified Respiratory Therapy Technicians (CRTTs), depending on their level of formal education in the field; there is currently a strong movement to require an associate degree (two years of post-secondary education) as the minimum entry level preparation for the profession.[3,4] To work as an RCP currently requires a professional license in 42 of the 50 United States, Washington DC, and Puerto Rico.

Respiratory care as a distinct health care profession developed in North America and at the present time exists in that form in only a few other places, notably Central America, the Philippines, and Taiwan. In most areas of the world there is no single health care profession whose practitioners are dedicated and specifically trained to deal with all aspects of the care of patients with respiratory problems.

Respiratory Care, The Subject Area

The term respiratory care also refers to a collection of principles, skills, and patient needs that have arisen because of the nature of respiratory disorders and their effects on individuals. In the introduction to his 1971 book, *Intensive and Rehabilitative Respiratory Care,* Thomas L. Petty used the term not to identify a specific allied health profession but to refer to a multidisciplinary approach to the management of patients with respiratory problems:[5]

> The development of an organized team-approach for management of patients with acute respiratory failure has been a major advance of today's medicine and has provided the arena for systematic physiologically oriented care. The disciplines of internal medicine, surgery, anesthesiology, nursing care, inhalation therapy, and physical medicine and rehabilitation all come to bear on problems presented by each individual case.

The context of Petty's description was the management of patients with acute respiratory failure, but its central feature—care that is systematic, based on physiology, and drawn from the expertise of multiple disciplines—applies to other settings as well. Respiratory care is not synonymous with critical care medicine, nor with pulmonary medicine or anesthesiology, although each of these medical specialties includes areas that coincide with aspects of the respiratory care profession and with elements of what American RCPs do.

Respiratory care the subject area is defined by the needs of patients. In the United States, many aspects of the subject area and the profession overlap. For example, in many acute care hospitals the care of a patient with acute respiratory failure would include the following components, each carried out by an RCP (under medical direction and increasingly according to a pre-established patient-driven protocol): arterial puncture and blood gas measurement, endotracheal intubation, initiation and adjustment of mechanical ventilation, endotracheal suctioning, administration of aerosol bronchodilators, and chest physical therapy. If the patient required transfer to another hospital, or intrahospital transport for diagnostic tests or therapeutic interventions during the period of critical illness, an RCP would assist and usually accompany the patient. After extubation (by an RCP) and transfer out of the intensive care unit, the patient might undergo pulmonary function testing (by an RCP), and subsequently enter a pulmonary rehabilitation program in which an RCP played a central role. Following discharge, the patient might be visited at home by an RCP to assist with oxygen therapy or other care.

Whether all of the functions listed above would be carried out by RCPs depends on regional practice patterns and local hospital policy. For example, in the hospital at which I am Medical Director of Respiratory Care, RCPs do not routinely draw arterial blood specimens or perform endotracheal intubation. Everything mentioned falls within the notion of respiratory care as a subject area, though, regardless of who does it. World-wide, most patients with respiratory disorders are cared for in health care systems without RCPs. In most places, intubation would be carried out and mechanical ventilation adjusted by a physician, whether intensivist, pulmonologist, or anesthetist; a nurse would suction the airway and administer aerosol medications; chest percussion and postural drainage would be done by a physical therapist; the ventilator would be maintained and serviced by an equipment technician or clinical engineer; pulmonary function testing would be by a respiratory physiologist; and pulmonary rehabilitation would be under the direction of a pulmonologist or physiatrist. Although the players may vary, the needs of patients are the same, and those needs are encompassed within the subject area of respiratory care (Fig. 1).

RESPIRATORY CARE, the Journal

Which of the above scenarios does this Journal serve? The answer, with certain reservations, is both. RESPIRATORY CARE is not an 'allied health' journal per se, although it is the official journal of the AARC. It is also the only peer-reviewed scientific publication dedicated specifically and exclusively to respiratory care as a subject area. Its contents and intended readership are determined primarily by the latter, although at present most of each month's copies are sent to members of the AARC.

A central feature of this Journal is the unifying role played by technology—for example, mechanical ventilation, artificial airways, aerosols, oxygen therapy, respiratory monitoring, and pulmonary diagnostics—as applied to the respiratory system. In this sense RESPIRATORY CARE is also "the Journal of Applied Respiratory Science." The name could be changed

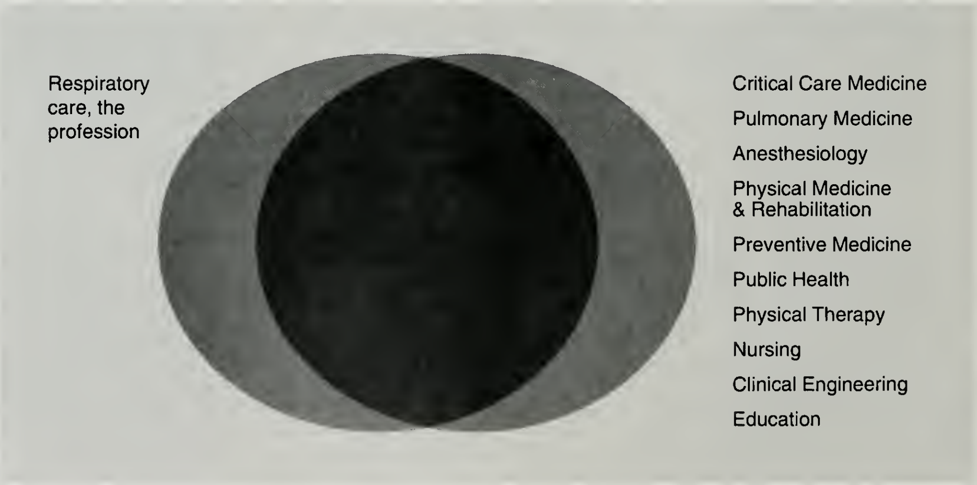

Figure 1: Conceptual representation of the distinction between respiratory care as a separate health care profession (represented by the left-hand oval), and respiratory care as a content area within each of the 10 disciplines represented by the right-hand oval. Respiratory care, the medical subject area, and RESPIRATORY CARE, the Journal, are properly concerned with the overlapped area of the two ovals. Both ovals contain areas that do not overlap and are outside the focus area of the Journal; in the case of the respiratory care profession (left-hand oval) the non-overlapping area would include such things as administrative, credentialing, regulatory, and economic aspects of the profession.

were it not for the fact that there are additional areas included under the term 'respiratory care,' such as patient outcomes, psychosocial and educational issues, and other things perhaps better described by 'care' than by 'science.'

This Journal is not primarily targeted at research into the nature of disease, but rather at topics for the clinician participating in the evaluation and care of patients with respiratory problems, particularly as these areas involve technology. Its overall goal is to be the leading journal for applied clinical pulmonary medicine, respiratory-related critical care, rehabilitation, and home care. Specific goals include augmenting the number and quality of submitted and published research papers, increasing the Journal's readership among physicians and other clinicians (including RCPs), increasing international participation both in reading and in contributing to the Journal, and enhancing the Journal's established role as a source for valuable teaching and reference documents.

The Journal's success will be measured by these things, and by increasing recognition by such institutions as the National Library of Medicine and its *Index Medicus*. Ultimately, however, this journal will succeed to the extent that it improves the care of patients, through more effective and safer devices and techniques, through more efficient use of resources, and through the better education of clinicians.

David J Pierson MD
Editor-in-Chief
RESPIRATORY CARE
Seattle, Washington

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The Information Superhighway's Expressway to RESPIRATORY CARE

"I feel the need ... the need for speed!" is one of my favorite lines from the movie *Top Gun.* Because I am a world-class limit-breaker, speed is an underlying theme in my life—fast-paced, do it faster, speed it up, express lanes, and expressways. And, if that weren't enough, I grew up in Oklahoma, where athlete Jim Thorpe coined the phrase, "Faster, stronger, higher!"

Thanks to the information superhighway, I can do much of my work—faster. For example, searching the National Library of Medicine's MEDLINE used to be a laborious, time-consuming process. Since the June 1997 innovation of Internet-accessible MEDLINE,[1] with the flick of a few keys, I'm actually speeding—checking references at a higher rate. Two years ago, when the American Association for Respiratory Care's web site www.aarc.org was launched, I began receiving e-mail, a faster, more efficient way to keep up with busy, traveling-around-the-world, patient-treating-not-sitting-at-a-desk respiratory care professionals.

Now, the Journal also accepts speeders—those clinicians who wish to work faster and more efficiently. With browser software, such as Netscape Navigator (Netscape Communications, Mountain View CA) or Microsoft Internet Explorer (Microsoft Corporation, Redmond WA), a modem, a personal computer, and a little time, readers have access to RESPIRATORY CARE 24 hours a day, 7 days a week. At our uniform resource locator (URL) address

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readers may browse the current issue of the Journal, seek assistance with writing a manuscript, and submit OPEN FORUM abstracts to the Journal office. RESPIRATORY CARE Online offers these sections: About RESPIRATORY CARE, Masthead information, Author Guide, Table of Contents, Online Resources, and Sponsors. Each section contains valuable information. Figure 1 describes the information currently available on the web site.

About RESPIRATORY CARE provides a historical perspective of the Journal. From the first editor to the annual OPEN FORUM, from publication categories to how to subscribe, this section also defines why the official science Journal of the AARC is important to the respiratory care community.

The Masthead lists the members of the Journal's Editorial Board and Staff.

Author Guide was developed to assist manuscript writers. Resources in this section are: the Revised Manuscript Preparation Guide, the Declaration of Helsinki, the Uniform Requirements for Manuscripts, and Standard Abbreviations and Symbols.

Table of Contents contains the latest RESPIRATORY CARE

and past issues from October 1997. From this page, users can access abstracts of original studies, the introductory paragraph and outline of review papers, the complete text of all our teaching features including: Graphics Corner, Test Your Radiological Skill, Cardiorespiratory Interactions, Drug Capsule, PFT Corner, and Kittredge's Corner. In addition, browsers will find Classic Reprints and other interesting items taken from the printed version of the Journal.

Online Resources includes the 1997 Author and Subject Indexes with quick search capabilities. If readers desire, they can submit letters to the editor, contact RESPIRATORY CARE Journal staffers via street addresses, phone numbers, fax numbers, or e-mail addresses. An outstanding feature on this page is the easy access authors will find to assist them with tracking their manuscript through the editorial process. **OPEN FORUM** will allow participants in the annual OPEN FORUM to submit abstracts via e-mail or to print the form.

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Fig. 1. Information currently available at RESPIRATORY CARE'S Web Site, www.rcjournal.com.

Information about the OPEN FORUM is located in the Online Services area of the RESPIRATORY CARE home page. Those clinicians wishing to submit abstracts can now send them via e-mail. Step-by-step instructions—which complement the requirements in our Call for OPEN FORUM Abstracts form (see Pages 73-74)—will spell out how to submit the e-mail abstract. By attaching the electronic file (saved as a text document, ie, a Microsoft Word-compatible file, with figures and tables saved as tiff files) to the e-mail, participants can send their abstracts directly to the mailbox openforum@aarc.org. This process will speed the submission process and may save time and money for participants. (For those who wish to send their abstracts the old-fashioned way, the Call for OPEN FORUM Abstracts form will be available on the web site and printed in every issue of the Journal for reproducing.) In addition, we will still accept Federal Express packages, U. S. Postal Service packages, and letters postmarked by the deadline dates, and telephone calls requesting copies of the form. A few words of caution: we will not accept a faxed version of an abstract and all deadlines still apply.

Recently, I read in the *British Medical Journal*[2-10] and in the *New England Journal of Medicine*[11-20] of the ongoing debate centering on the speculation that someday journals will become obsolete and that peer review will become dated and irrelevant. Balderdash!

As a member of this staff, let me reassure all readers that original studies, review papers, and teaching features whether printed on paper or on our Internet site will still adhere to the principles this Journal has always espoused—strong scientific reasoning, methodology, peer review. Furthermore, all papers will still be submitted to the same standards of copyediting and publishing.

This new technology will add value to the services of the Journal and the American Association for Respiratory Care. It will, in some cases, add ease to the submission of abstracts, the tracking of manuscripts by authors, and the accessibility of the Journal's editors and staff. But, it will not compromise our position for disseminating clinical and scientific evidence for the practice of respiratory medicine.

The Internet opens up an expressway—from us to respiratory care professionals and back to us. We hope that this new technology will continue to be a well-used resource. However, we also understand that not everyone has access to the Internet and that there are some among us who do not enjoy the company of computers or technology. For those in this camp, let me say that our telephone lines and mailing addresses still work, quite well.

Kris Williams
Assistant Editor
RESPIRATORY CARE
Dallas, Texas

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A Pediatric Asthma Unit Staffed by Respiratory Therapists Demonstrates Positive Clinical and Financial Outcomes

Timothy R Myers BS RRT, Robert L Chatburn RRT, and Carolyn M Kercsmar MD

BACKGROUND: We sought to determine the effects of an Asthma Care Unit (ACU), staffed primarily by respiratory therapists (RTs), on length of stay (LOS), hospital cost, charges to payers, care path variances and postdischarge outcomes for children admitted to our hospital. METHODS: From Sept 1, 1996-Apr 30, 1997, patients were admitted to the ACU. A control group was compiled from multiple patient units staffed primarily by registered nurses (RNs), using asthma care path (ACP) data from Oct 1, 1995-Aug 31, 1996. All patients were treated for asthma by the same protocol. Patients admitted to the pediatric intensive care unit were excluded from both study groups. Deviations from the care path protocol were tracked for each patient. All asthma patients were followed up with a telephone survey to monitor postdischarge morbidity. RESULTS: Mean values (standard deviations, SD) for LOS, care path variances, hospital cost/case, and patient charges/case were compared using unpaired Student's *t* tests. Outcome variables showed a significant difference: LOS [ACU = 1.78 (0.75) d and Control = 2.04 (0.85) d; $p = 0.0003$]; care path duration [ACU = 1.41 (0.66) d and Control = 1.75 (0.72) d; $p = 0.028$]; care path variances [ACU = 2.7 (2.5) and Control = 9.4 (5.3); $p < 0.0001$]; hospital cost/case [ACU = $1,375 ($600) and Control = $1,522 ($750); $p = 0.023$]; and patient charges/case [ACU = $2,447 ($1,079) and Control = $2,732 ($1,319); $p = 0.025$]. Mean values (SD) for functional morbidity outcomes showed no increase in symptomatic days [ACU = 4.9 (7.7) and Control = 5.6 (7.2); $p = 0.346$] or parent workdays missed [ACU = 3.9 (3.1) and Control = 3.3 (3.6); $p = 0.358$]. However, there was a significant difference in school days missed [ACU = 5.3 (3.6) and Control = 3.8 (4.5); $p = 0.026$]. CONCLUSION: An ACU staffed by RTs was associated with a reduced LOS and care path variances and lower costs of care compared to standard treatment by RNs. These outcomes were realized with no increase in postdischarge functional morbidity. Average cost savings/case was $150. Estimated hospital cost savings/year at this hospital is $135,000. An additional $170,000 could be saved in the conversion of full-time RNs to RTs and patient care assistants. [Respir Care 1997; 43(1):22-29]

Introduction

Asthma is one of the most common chronic pediatric diseases today, affecting 3-5 million children in the United States. Recent data not only reveal increases in the prevalence of asthma but also a rise in the number of hospitalizations, especially in children less than 5 years old.[1-3] Asthma is now the most common discharge diagnosis in pediatric hospitals.[4-5] A recent estimate of the annual health care expenditures for asthma and asthma-related care was $6.4 billion with 43% of acute care dollars spent on emergency visits, hospitalizations, and costs associated with death from asthma.[6] The financial

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Mr Myers is Asthma Care Manager; Mr Chatburn, Director, Respiratory Care Services; and Dr Kercsmar, Director, Pediatric Asthma Center, University Hospitals of Cleveland, Rainbow Babies & Childrens Hospital. At Case Western Reserve University Mr Myers is Asthma Clinical Studies Coordinator; Mr Chatburn, Assistant Professor; and Dr Kercsmar, Associate Professor Pediatrics—Cleveland, Ohio.

Mr Myers presented a version of this paper during the annual OPEN FORUM at the 43rd International Respiratory Congress, December 6-9, 1997, in New Orleans, Louisiana.

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impact of functional morbidity associated with pediatric asthma, such as symptomatic days, nocturnal symptoms, limitations of daily activities, school absenteeism, or parent workdays missed, accounts for billions of dollars.

With the expansion of managed care and capitated health care dollars into more markets, cost-effective disease management is becoming critical to the fiscal success and viability of most hospitals. The advent of Care Maps,™ care paths, and therapist-driven protocols has taken great strides in addressing and providing high-quality, cost-effective patient care by disease and procedure management.[7-11] There have been many attempts to improve chronic management of asthma by both physicians and their patients with varying levels of success.[12-14] However, programs addressing the acute management of hospitalized asthmatics are sparse and mainly adult oriented.[15,16] Prolonged hospital lengths of stay and high treatment cost are profoundly influenced by the variability in patient and/or disease management provided by numerous caregivers.[15-18]

We hypothesized that using respiratory therapists in a disease management model would improve efficiency of care compared to our normal method of random placement of patients throughout multiple patient units as measured by decreases in care path variances, length of stay (LOS), and hospital costs and charges to third-party payers. We further hypothesized that these benefits would occur without a concomitant increase in functional morbidity indicators post-discharge (ie, symptomatic days, school days missed and parents' workdays missed).

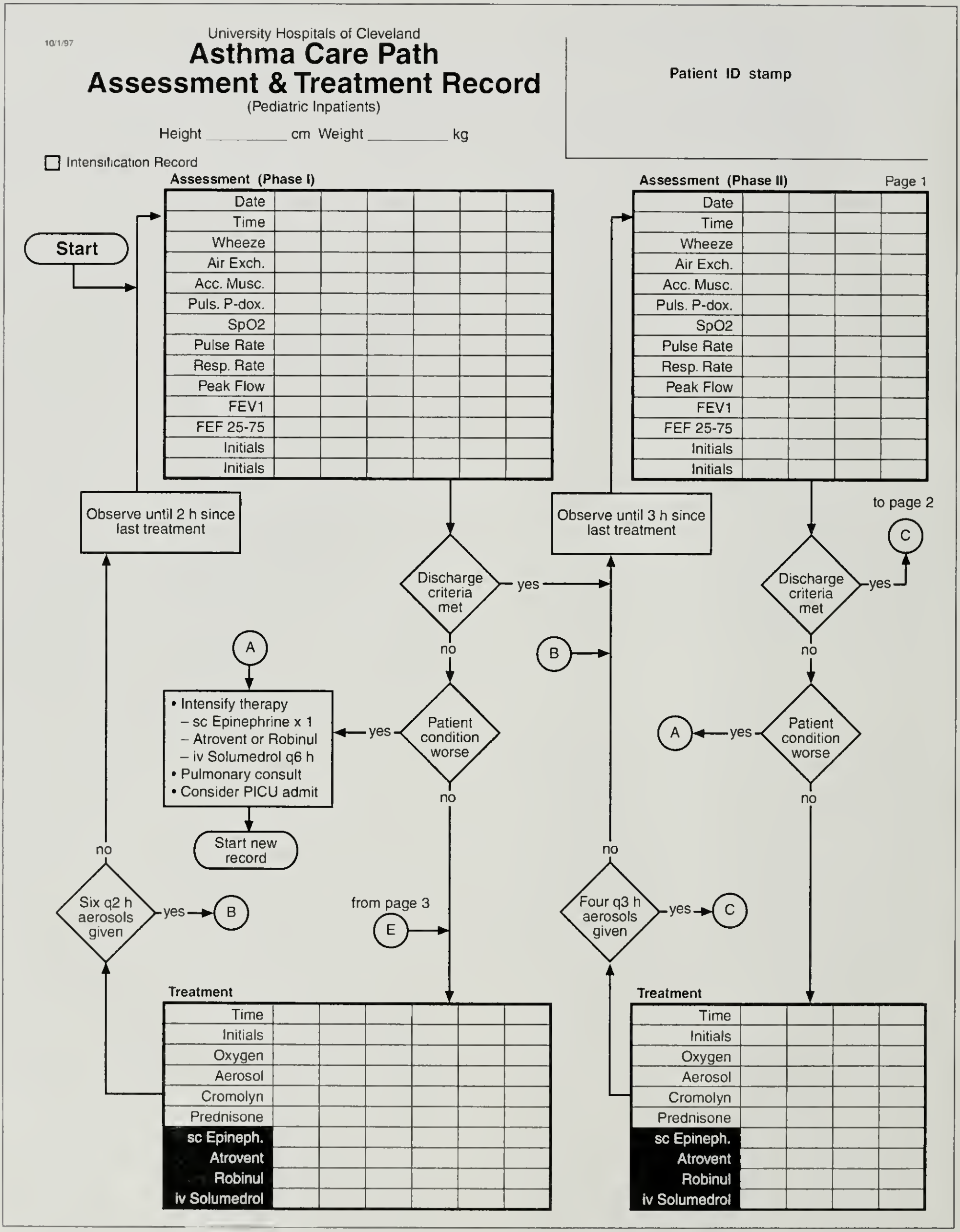
Methods

Since August 1995, the standard method of all inpatient treatment for asthma at our children's hospital has been an asthma care path (ACP) protocol. From September 1996 through April 1997, all patients who were admitted with status asthmaticus were placed in our new Asthma Care Unit (ACU). This pediatric unit was designed specifically for disease management of asthma and was staffed primarily with respiratory therapists and newly hired patient care assistants. Registered nurses assigned as the division charge nurse (non-patient assignment nurse) provided supplemental coverage for twice-a-day patient system assessments and medications not authorized to be administered by respiratory therapy. Prior to the opening of the ACU (October 1995-June 1996), all admitted patients treated according to the ACP were placed in various patient units, according to age and bed space availability. All patients in this study were enrolled in the same ACP protocol. The asthma care path was approved by the relevant Institutional Review Boards of University Hospitals of Cleveland. This protocol was the standard method of treatment at our hospital and has been used to effectively decrease the average LOS for pediatric status asthmaticus by more than a full day.[19] The ACP protocol excludes patients if they have other underlying chronic cardiac or respiratory diseases (ie, congenital heart defects, cystic fibrosis, and bronchopulmonary dysplasia) or are less than 1 year of age. All patients that initially required intensive care treatment for their asthma (receiving aerosols more frequently than every 2 hours) prior to being admitted to the divisions or ACU were excluded from the study groups. Intensive care patients were excluded due to the variability in asthma care (secondary to the absence of a standard intensive care treatment protocol for asthma) and the resulting fluctuations in intensive care LOS.

The ACP protocol uses a standardized, unique 'algoform' (ie, combination algorithm and patient data form) developed at our institution to treat all pediatric asthma (Fig. 1). The algoform serves as a step-by-step treatment algorithm based on the National Institute of Health's guidelines for pediatric asthma.[20] Assessment and discharge criteria (Table 1) and an algorithm for concomitant oxygen therapy were included on the algoform. Within the flow process of the algorithm are areas of documentation for standardized assessments (wheeze, air exchange, accessory muscle use, respiratory rate, and pulse oximetry) and treatments (2.5 mg of albuterol in 2 cc of normal saline or cromolyn sodium). All patients are immediately placed on the ACP at admission. All patients receive assessments and/or aerosols at a starting frequency of every 2 hours and are ready for discharge after receiving 2 aerosol treatments at the every-6-hours frequency. Patients failing to progress through the care path or worsening with treatment receive a standard intensification treatment regimen (0.01 mg/kg subcutaneous epinephrine, 500 μg of ipratropium in 5 mg of albuterol and a return to every-2-hour assessments and/or treatments). Patients automatically have the frequency of their aerosols reduced by (a) achieving a preset discharge criteria (Table 1) based on the standardized assessments or (b) receiving 12 hours of treatment at any phase. All patients age 7 years or older also receive bedside spirometry (Spirovit SP-10, Schiller America Inc, Tustin CA) twice/ day. The children were asked to perform 3 reliable forced vital capacity (FVC) maneuvers/session, with the best results for forced expiratory volume in the first second (FEV_1), FEV at 25-75% of FVC (FEF_{25-75}), and peak expiratory flow being recorded on the patient's treatment algoform.

The ACP protocol also contains minimum education outcome requirements that all patients and parents must achieve prior to discharge. Patients and parents were required to demonstrate knowledge and proper medication use, symptom recognition, and trigger avoidance prior to discharge.

To determine the severity of each patient's chronic asthma (not the severity of the acute episode), measures of health care utilization (unscheduled visits and hospitalizations, intensive care admissions, and more than 3 asthma medications) and daily functional morbidity (symptoms, sleep disruption, activity limitation, and school or daycare absences) were used. Patients were classified as having mild, moderate or severe underlying disease (Table 2). Data were collected prospectively for all asthma patients upon admission as part of a standard history and physical examination.



10/1/97

University Hospitals of Cleveland

Asthma Care Path

Assessment & Treatment Record

(Pediatric Inpatients)

Height ____________ cm Weight ____________ kg

☐ Intensification Record

Patient ID stamp

Page 1

Assessment (Phase I)

Date						
Time						
Wheeze						
Air Exch.						
Acc. Musc.						
Puls. P-dox.						
SpO2						
Pulse Rate						
Resp. Rate						
Peak Flow						
FEV1						
FEF 25-75						
Initials						
Initials						

Assessment (Phase II)

Date				
Time				
Wheeze				
Air Exch.				
Acc. Musc.				
Puls. P-dox.				
SpO2				
Pulse Rate				
Resp. Rate				
Peak Flow				
FEV1				
FEF 25-75				
Initials				
Initials				

Treatment

Time						
Initials						
Oxygen						
Aerosol						
Cromolyn						
Prednisone						
sc Epineph.						
Atrovent						
Robinul						
iv Solumedrol						

Treatment

Time				
Initials				
Oxygen				
Aerosol				
Cromolyn				
Prednisone				
sc Epineph.				
Atrovent				
Robinul				
iv Solumedrol				

Fig. 1. Sample of Asthma Care Path 'algoform' (page 1 of 4), showing the first 2 of 4 treatment phases. © CM Kercsmar, 1997.

Table 1. Symptom Classification and Discharge Criteria for Asthma Care Path Assessments.

	Symptom Classification		
	Good	Fair	Poor
Wheeze	None or end expiratory wheeze	Inspiratory & expiratory wheezes	Breath sounds becoming inaudible
Air exchange	Equal in all lobes	Decreased in some lobes	Decreased in all lobes
Accessory muscles	None	Intercostal and tracheosternal retractions	Same as moderate with use of sternocleidomastoids
S_{pO_2}	≥ 94%	91% – 93%	< 90%

Discharge Criteria

Wheeze	Good
Air Exchange	Good
Accessory Muscles	Good
S_{pO_2}	≥ 94%
Respiratory Rate	< 40

Table 2. Criteria Used to Score Severity* of Underlying Asthma.

	Score		
Symptom	1	2	3
Cough or wheeze	< weekly	1-2 times/week	> 2 times/week
Play/exercise limitations	Sometimes	Often	Always
Nocturnal cough/wheeze	< 1 time/week	2-3 times/week	> 3 times/week
School absences/year	< 10 days	10-20 days	> 20 days

Other Factors (Score = 9 each)

- > 3 Unscheduled ER/MD visits for asthma in past year
- > 2 Hospitalizations for asthma in past year
- 1 Intensive care admission for asthma
- Use of > 3 medications for asthma concomitantly (in past 6 months)

---

*The severity score was the sum of all categories listed above during baseline in the past 3 months. Severity categories: mild disease < 4, moderate disease 5–8, and severe disease > 8.

To monitor posthospitalization outcomes, we developed a telephone follow-up survey to be administered to all patients who were treated with the ACP. Written consent was obtained from the patients' legal guardians to administer the follow-up calls. The calls were made 72 hours to 3 weeks after the child was discharged from the hospital. The survey was used to monitor and track outcome variables, such as symptomatic days, school days missed, workdays missed by parents, medication recall, asthma treatment plan recall, need for extra treatments and readmission, and emergency room visits or unscheduled asthma visits to their primary physician following hospital discharge. In administering the postdischarge follow-up survey, school days missed or workdays missed by parents were calculated from the day of discharge to the day of self-reported return to school or work. We did not adjust the number for weekends or normal days off from school (ie, holidays or other scheduled days off). The number of symptomatic days was calculated from the day of discharge to the day of the self-reported absence of symptoms.

We prospectively collected the results (clinical and postdischarge) of all patients admitted on the ACP protocol for both the study group and historical control group directly from the patient algoforms. The algoforms are an official part of each patient's chart; a facsimile copy of this algoform was transmitted to the study coordinators at discharge. Data were entered into a database designed specifically to track outcomes and predefined care path variances (deviations from the ACP). Outcome variables of most interest were identified a priori and a power analysis (2-tailed *t* test) was used to determine an appropriate sample size. In order to detect a difference in LOS of 0.25 days, an interval determined to be clinically significant in light of a recent major reduction in LOS,[21] 250 patients would be needed in each group ($a = 0.05$, $1 - \beta = 0.80$).

Statistics

Unpaired Student's (2-tailed) *t* tests were used to compare mean values of the major outcome variables: care path variances, hospital LOS, care path duration, hospital cost/case, and charge to third-party payers. Secondary outcome variables, symptomatic days, school days missed and parents' workdays missed were also compared with Student's *t* tests.

Possible confounding variables were analyzed with either Student's *t* tests or the Fisher's exact test. Possible confounding variables included: patient age, admission through the emergency department, initial pulse oximetry values, FEV_1 at admission and discharge, number of aerosol treatments and assessments, supplemental oxygen requirement (ie, yes or no), percent of patients advanced due to time limits rather than clinical signs, and number of patients. Percentages by race were compared using a Fisher's exact test. Asthma severity was determined based on a scoring of chronic asthma symptoms and history (Table 2). Distributions by severity class were then compared with a χ^2 test. For all tests, $p < 0.05$ was considered significant.

Results

There were 262 patients in the ACU group and 267 patients in the historical control group. Table 3 shows the demographic variables expressed as mean values (standard deviations, SD), percentages, or whole numbers. There were no differences between the 2 groups in age (p = 0.191), race (p = 0.839), percentage of admissions through the emergency department (ED) (p = 0.504), or by distribution of disease severity (p = 0.792).

Table 3. Demographic Characteristics and Disease Severity of ACU and Control Patients.

	ACU n = 262	Control n = 267	p Value
Mean Age [y (SD*)]	6.3 (4.5)	6.8 (4.8)	0.191
Race			
Caucasian	24.3%	23.5%	0.839
Noncaucasian	75.7%	76.5%	
Gender			
Male	183†	153	0.002‡
Female	79	114	
Admissions from the Emergency Department	187	184	0.504
Disease severity			0.798
Mild	126	132	
Moderate	30	32	
Severe	82	74	
Unknown	24	29	

*SD = Standard deviation.
†Unless otherwise indicated, figures are numbers of patients.
‡Statistical difference.

There was a difference between gender of the ACU group and the control group (Table 3) with a higher percentage of boys in the ACU group. However, there was no difference within treatment groups between boys and girls in LOS (ACU p = 0.110 and control p = 0.107).

There was a 71% reduction in care path variances for patients in the ACU compared to the control group. Patients in the ACU had a 13% reduction in hospital LOS and a 10% decrease in both cost/case and charges/case. Table 4 indicates a reduction for ACU patients in the amount of time spent on the care path (care path duration). Although data from the 2 groups spanned different time periods, Figure 2 shows that seasonality probably had no effect on LOS. There were no differences between the 2 groups in possible confounding variables except that a greater percentage of patients in the control group required supplemental oxygen (p = 0.036). However, there was no difference in admission S_{pO_2} (p = 0.804) or FEV_1 (p = 0.149). Although the number of patients advanced (less frequent therapy) for time-limiting factors was not statistically significant (p = 0.06), patients in the ACU met advancement criteria less frequently than the control group.

Table 5 shows mean values (SD) for functional morbidity outcomes posthospital discharge. There was no significant difference between the 2 groups in symptomatic days (p = 0.346) or days of work missed by parents (p = 0.358). However, the historical control group showed fewer school days missed after discharge (p = 0.026).

Table 4. Inpatient Outcomes of ACU and Control Patients.

	ACU	Control	p Value
Variances/case	2.7 (2.5)*	9.4 (5.3)	< 0.0001†
Length of stay (days)	1.78 (0.75)	2.04 (0.85)	0.0003†
Care path duration (days)	1.41 (0.66)	1.75 (0.72)	0.028†
Hospital cost/case	$1,375 ($600)	$1,522 ($750)	0.023†
Patient charge/case	$2,447 ($1,079)	$2,732 ($1,319)	0.025†
Initial S_{pO_2} value	93.7 (2.4%)	93.8 (2.6%)	0.804
Admission FEV_1	61.3 (19.6)	56.2 (19.5)	0.149
Discharge FEV_1	66.4 (18.4)	56.2 (21.0)	0.231
Oxygen therapy	30.8%	39.7%	0.036†
Aerosols	10.4 (5.3)	10.5 (5.5)	0.795
Assessments	12.4 (5.0)	12.6 (5.3)	0.786
Advanced by time limit	31.9%	27.2%	0.062
Intensified therapy	14.6%	19.9%	0.134

*Unless otherwise indicated, figures are means and standard deviations.
†Statistical difference.

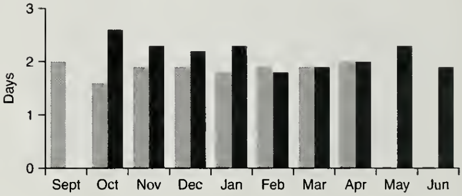


Figure 2. Seasonal variability in length of stay (LOS) using the asthma care path. ■ = mean LOS for patients in the control group. ▨ = mean LOS for patients managed in Asthma Care Unit.

Table 5. Functional Morbidity Outcomes of ACU and Control Patients.

	ACU	Control	p Value
Symptomatic days	4.9 (7.7)*	5.6 (7.2)	0.346
School days missed	5.3 (3.6)	3.8 (4.5)	0.026†
Work days missed	3.9 (3.1)	3.3 (3.6)	0.358

*Data are mean number of patients with the Standard Deviation.
†Statistical difference.

Table 6 provides an analysis of the cost savings associated with using respiratory therapists instead of registered nurses. There were no licensed practical nurses or patient care assistants providing care for asthmatics during the control period.

Discussion

Prolonged LOS and high treatment costs are associated with variations in disease management provided by multiple caregivers.[15-18] We demonstrated that an asthma care unit with respiratory therapists as the primary caregivers can deliver individualized, high-quality care within a standard setting resulting in a reduction of LOS, care path variances, cost, and charges

Table 6. Cost Analysis of Staffing and Salaries of Control Group and Asthma Care Unit.

Available time/ FTE* (hr)	Registered Nurses	Respiratory Care Practitioners	PCA
	2,080	2,080	2,080
PTO (hr/yr)	120	120	120
Vacation time (hr/yr)	120	120	80
Nonproductive time (hr/yr)	122	122	122
Adjusted available time/ FTE (hr/yr)	1,718	1,718	1,758
Required FTEs for 24-hr coverage 7 days/week	4.8	4.8	5.0
Staff/shift to cover workload	2	1	1
Required FTEs	9.6	4.8	5.0
Base pay (hr)	$20.04	$17.01	$10.42
Benefits (22.5%)	4.51	4.10	2.34
Estimate overtime	$0	$0	$0
Yearly salary/FTE	$53,615	$43,909	$26,550

Cost Savings Analysis

	Staff Type		FTEs	Annual Salaries
Control	RNs		9.6	$514,704
		Total	9.6	$514,704
ACU	RRT		4.8	$210,762
	PCA		5.0	$132,750
	RN		0.03	$1,609
		Total	9.83	$345,121
		Cost savings		$514,704
				$345,121
				$169,583

*FTE = full-time employee; PCA = patient care assistants; PTO = paid-time off; RNs = registered nurses; ACU = Asthma Care Unit; RRT = Registered Respiratory Therapist.

associated with pediatric asthma. The reduction in the LOS between the groups was not related to a difference in admission and/or discharge processes. The ACU group spent 79% of their hospitalization on the ACP compared to 86% for the control group (care path duration divided by hospital LOS). This indicates the control group actually spent less time not receiving treatment prior to being discharged than the ACU group (ACU: 1.78 – 1.41 = 0.37 vs Control: 2.04 – 1.75 = 0.29). All patients from both groups were immediately treated with the ACP. These improvements in clinical and financial outcomes were achieved without a concomitant increase in patients' functional morbidity or quality of life outcomes after discharge.

By coincidence, there was a difference between gender in the ACU group and the control group (Table 3), with a higher percentage of boys in the ACU group. In a pediatric population, boys tend to have more severe disease than girls.[2,4,11] Although it is possible that gender could influence underlying disease severity, there was no difference within treatment groups between boys and girls in LOS. Therefore, the gender imbalance between groups did not account for the improved LOS in the ACU group.

There was a difference in the use of supplemental oxygen between the 2 groups despite the fact that there was no difference found between mean FEV_1 at admission (for children ≥ 7 years of age) or mean initial pulse S_{pO_2} (Table 4). There also was no difference between the amount of therapy given or the percentage of patients intensified for worsening of asthma or failure to progress in therapy (Table 4). This may indicate that the control group unnecessarily received oxygen, that after admission the disease worsened with less aggressive treatment or monitoring, or that the patient(s) had a secondary diagnosis (eg, atelectasis, pneumonia). However, no patient in either group was required to remain in-hospital because of continued use of supplemental oxygen (ie, use of supplemental oxygen after the second every-6-hours aerosol administration). Based on this information, we believe that the difference in the use of supplemental oxygen did not account for the improved LOS in the ACU group.

Our study had several limitations. First it was not a randomized, controlled trial. The use of a historical control group raises the potential for bias.[22,23] However, both groups used the same asthma protocol and the historical control group had documented major reductions in length of stay prior to this study.[19] Another limitation was the control group included 2 months (May-June) of the year that the ACU group did not, while the ACU group included September. However, Figure 2 shows little variability in length of stay (by month) of each study group.

The inability to track and calculate missed school days is a potential limitation of our study. There was a difference in the average number of school days missed, despite no difference in the number of symptomatic days, parent workdays missed, or FEV_1 at discharge (Tables 4 & 5). In administering the post-discharge follow-up telephone survey, the number of days of school missed was calculated from the day of discharge to the day of self-reported return to school. We did not adjust the number for weekends or normal days off from school. The ACU group had a larger population attending school (ACU = 94 and control = 55) and contributed significantly to the large difference in total number of school days missed (ACU = 499 and control = 209). There was also a difference in the potential number of school days available to be missed due to the asthma exacerbation (total school days: ACU = 153, control = 127), in part accounting for reported differences. Because ACU patients did not have more symptom days or a lower FEV_1 at discharge (Table 4) than controls, it is unlikely that ACU patients were discharged home 'sicker' than those in the control group, and it is unlikely that this accounts for the larger number of missed school days.

The construction and development of the asthma 'algoform' (Fig. 1) was performed by a committee led by respiratory therapy and pulmonary medicine specialists. This unique documentation and instructional tool was one of the keys to the success of our asthma management program. The asthma protocol was piloted several times with varying levels of success. Based on the results of the pilot trials, the algoform was developed to serve 2 purposes. First, the algorithm portion of this form provides caregivers a step-by-step approach to correctly utilize the asthma protocol without constantly referring to an instruction manual or other supplemental information (eg, scoring forms). Second, the format directly links assessment to treatment so that it is simple to demonstrate both indications for and outcomes of drug therapy.

Another unique feature of the 'algoform' format is that the link between assessment and treatment is not mediated by an arbitrary set of measures or observations that vary among patients and care providers. Unlike previous scoring systems which utilized numerical values, we used a simple chest assessment comprised of several objective and subjective measures grouped into defined categories.[24-28] This allowed easy and rapid identification of patient progress in the asthma care path and kept patient assessment simple, yet grounded in observable patient responses rather than mathematical constructs. In addition, limiting advancement solely to a score would have delayed discharge for almost one third of the patients in our asthma care path. These patients did not meet our predicted discharge criteria at some phase of treatment, but were still advanced because they had reached the 12-hour time limit (Table 4). Less than 3% of the patients advanced by time required any intensified treatment, and successfully completed the care path; indicating that advancement by time constraint is a reasonable strategy.

The second key component in the success of the asthma care path was the hiring of the first care manager at University Hospitals of Cleveland. The care manager educated all staff on the correct use of the asthma care path, coordinated the asthma care of all patients admitted to our hospital, monitored care path outcomes (patient, clinical, and financial), and tracked predetermined care path variances. Because respiratory therapists have significant knowledge of the pulmonary system, pulmonary function testing, and techniques of respiratory care, it seemed logical to name a therapist as the care manager.

Respiratory therapists can play a valuable role in the treatment of pediatric patients hospitalized in status asthmaticus. Familiarity with practice guidelines and the disease process of asthma has a significant clinical and cost-saving effect in a hospital setting.[8-11] With the continual growth of managed care markets and reimbursement capitation by disease, these cost reductions in children hospitalized with status asthmaticus cannot be ignored. The average cost savings/patient in the ACU was $150/patient (see Hospital Cost/Case in Table 4). This was in addition to a cost savings of $847/patient that was achieved with initial implementation of the care path (before the ACU).[19] The overall savings to our institution with the initiation of the care path and asthma unit staffed by respiratory therapists is approximately $1,000/patient [(ACP savings = $847) + (ACU savings = $150) = $997]. Asthma accounts for 14% of all pediatric patients discharged from our hospital in a calendar year. At our institution, this averages between 800-1,100 pediatric asthma admissions/year (1993-1996). The overall estimated cost savings in implementing the ACP at our institution's asthma unit is approximately $1 million/year. The cost reduction is based solely on the reduced LOS at our original day charge, assuming all care was provided by RNs. An additional cost savings associated with switching from an all registered nursing staff to a staff of registered therapists and nursing assistants was approximately $170,000/ year (Table 6). Therefore we estimate the actual annual cost savings of the ACU over our standard practice of 1995 at $1.06 million/year (based on our average yearly census of 900 asthmatics/year). This cost savings was realized without any detrimental effect on the quality of patient care.

Respiratory therapists have shown their effectiveness and abilities in the role of asthma educators in past studies.[29,30] This study demonstrates a clinically important and cost-effective way to manage a growing chronic pediatric disease in an inpatient setting by utilizing respiratory therapists. We are currently working with other children's hospitals to determine whether our ACP (and its benefits) are generalizable to other institutions. However, a recently published study documented no effect on clinical outcomes by utilizing an asthma care pathway.[31]

Researchers often argue that 'evidence-based medicine' (the practice of basing clinical decisions and processes on published scientific evidence) is appraised primarily by prospective, randomized, controlled studies. This argument has recently been debated and challenged in editorials published in RESPIRATORY CARE.[32,33] Other efforts (benchmarking data) have been studied and have led to changes in clinical decisions and processes.[34] However, future prospective, randomized studies are necessary to document both the effects of asthma care pathways and the role of respiratory therapists in asthma units and pathways.

Conclusion

The American Association for Respiratory Care has challenged its members to document the clinical and economic impact of respiratory care practitioners in the delivery of health care. In our study, a pediatric asthma care unit staffed by respiratory therapists was associated with a reduced LOS and care path variances and lower costs of care compared to treatment on scattered nursing divisions by registered nurses. The average cost savings (ie, hospital fixed plus variable) per case was $150. The estimated hospital cost savings/year of an asthma unit (based on a 4-year average census of 900 patients) is $135,000 (an additional $170,000 could potentially be saved in the conversion of full-time registered nurses to respiratory therapists and patient care assistants). These outcomes were realized without an adverse effect on quality indicators or functional morbidity outcomes postdischarge. Further prospective, randomized trials comparing asthma care units versus control patient groups are necessary to confirm these results.

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In-Hospital Resuscitation

A Statement for Healthcare Professionals From the American Heart Association Emergency Cardiac Care Committee and the Advanced Cardiac Life Support, Basic Life Support, Pediatric Resuscitation, and Program Administration Subcommittees

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The Emergency Cardiac Care (ECC) Committee of the American Heart Association first published guidelines for cardiopulmonary resuscitation (CPR) and ECC in 1974.[1] Updated in 1980, 1986, and 1992, the AHA guidelines are now recognized as the world's most authoritative resuscitation guidelines.[2-4] To implement these guidelines, however, hospitals need to establish a systems approach to in-hospital resuscitation rather than depend on the skills of individual professionals. The success and acceptance of the out-of-hospital Utstein-style recommendations[5] led the AHA to help develop specific recommendations for documenting in-hospital resuscitation. The Utstein-style recommendations for uniform reporting of in-hospital resuscitations present important recommendations for all hospital facilities.[6] With publication of these recommendations, members of the ECC Committee recognized the need to summarize the major actions that enable a hospital to fulfill the resuscitation recommendations.

Ethical Concerns

CPR is one of the few interventions that requires an order to not be administered. Resuscitation efforts, however, are not appropriate for all hospital patients. When indicated, healthcare providers discuss with patients, families, and surrogate decision-makers their options and preferences for resuscitation. Hospitals have in place clear policies that address medical futility, patient self-determination, and do-not-attempt-resuscitation orders.

In-Hospital 'Chain of Survival'

The chain of survival, first conceptualized for out-of-hospital sudden cardiac arrest,[7] applies to in-hospital arrest as well.[8] Successful resuscitation requires early recognition of cardiopulmonary arrest, early activation of trained responders, early CPR, early defibrillation when indicated, and early advanced life support (ALS). The hospital creates a coordinated, multidisciplinary approach to treating patients with a cardiopulmonary emergency. To establish this approach, the hospital provides written policies and procedures that address and facilitate the following recommendations.

Basic Life Support

All hospital staff who may need to respond to a sudden cardiopulmonary emergency are trained in basic life support (BLS)

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and, when appropriate, in the use of automated external defibrillators (AEDs). Such AED training is considered a basic skill for healthcare providers, particularly when professionals trained in ALS are not immediately available. Staff members maintain their CPR and AED skills with regular refresher training. Instruction in CPR and use of an AED follow the AHA guidelines. Barrier and noninvasive airway devices are available for immediate use in all patients.

Early Defibrillation

Hospitals are able to identify and shock patients in ventricular fibrillation or pulseless ventricular tachycardia within the shortest possible interval. Cardiac arrest response teams, because they bring defibrillators from only a few locations in a hospital, may not always achieve the goal of early defibrillation. To reduce the time from collapse to defibrillation, defibrillators, including AEDs and conventional defibrillators with shock advisory capabilities, are readily available in strategic areas throughout the facility. Hospitals extend training and authorization to use conventional, automated, and shock advisory defibrillators to all appropriate nonphysician staff, including nurses, respiratory therapists, and physician assistants.[9]

Advanced Cardiac Life Support

Hospitals have a multidisciplinary response team that includes personnel trained and authorized to provide endotracheal intubation, intravenous medications, transcutaneous pacing, and rhythm and 12-lead electrocardiogram interpretation. In some settings this advanced cardiac life support (ACLS) response appropriately may be delivered by rapidly responding emergency medical system providers. Hospitals have available personnel with these advanced skills, in a timely manner, not only to patients who occupy a hospital bed but for all patients, including patients in outpatient clinics, diagnostic services areas, satellite facilities, and public response areas such as cafeterias and waiting rooms. Some patient care areas, such as the emergency department and critical care units, may not require special response teams if the regular staff members provide these skills.

To ensure common treatment protocols and well-organized resuscitation efforts, healthcare professionals with a reasonable expectation of involvement in resuscitation efforts complete provider, review, or advanced provider courses in the areas of ACLS or pediatric ALS every 2 to 3 years. Treatment protocols adhere to AHA training and guidelines for pediatric resuscitation and adult ACLS. Depending on a facility's goals and types of patients, not all ALS interventions, such as endotracheal intubation and intravenous medications, are required. As a minimum, however, hospitals provide all appropriate immediate-response healthcare personnel with training in BLS and use of AEDs.

Event Documentation

All resuscitation efforts are documented accurately by recording specific treatment interventions, event variables, and outcome variables. Resuscitation teams designate a specific recorder to provide event documentation. The in-hospital Utstein guidelines provide a standard reporting form for in-hospital CPR.

Quality Assurance and Quality Improvement

Hospitals establish an interdisciplinary committee whose members have expertise in CPR to assess the quality and efficacy of the facility's resuscitation efforts. To help with this assessment, the in-hospital Utstein guidelines recommend a set of uniform data that includes patient variables, event variables, outcome variables, and hospital variables to collect and review. In addition, the Utstein guidelines recommend gold standard process indicators (eg, time to defibrillation) and several outcome indicators (eg, percent of patients discharged from the hospital alive) to be assessed at regular intervals. Hospitals incorporate these indicators into a program for quality monitoring and continuous quality improvement. Critical care units are not excluded from this recommendation. This quality-improvement program provides feedback, education, and training to resuscitation personnel and staff.

Administrative Support

Hospital administrators ensure the availability of appropriate equipment and provide the resources to support the training, education, quality monitoring, and quality-assurance activities required to create a strong chain of survival.

Interhospital and Intrahospital Comparisons

The in-hospital Utstein guidelines provide a detailed checklist of information to include in reports on in-hospital resuscitation and provide a reporting template to summarize a facility's resuscitation experience. Such a uniform reporting style will support both intrahospital and interhospital comparisons of resuscitation activities. The goals of these comparisons are quality improvement for individual hospitals and better understanding of what works and does not work in hospital resuscitation.

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CORRECTION: QUESTIONS FOR GRAPHICS CORNER

The questions corresponding to Figure 1 in Hargett K, et al [Respir Care 1997;42(12):1184-1194] were inadvertently omitted.

The correct sequence of questions is:

(1) Identify the two types of breaths shown.
(2) What characteristics are unusual about the first breath?
(3) What is unusual about the second breath?

We regret the omission. Please visit our web site at www.rcjournal.com for the corrected and complete Graphics Corner.

Recommended Guidelines for Reviewing, Reporting, and Conducting Research on In-Hospital Resuscitation: The In-Hospital 'Utstein Style'

A Statement for Healthcare Professionals From the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa

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This scientific statement is the product of the Utstein '95 Symposium held June 23-24, 1995, at Utstein Abbey, Island of Mosteroy, Rogaland County, Norway. Draft versions were circulated for comment to participants of the Utstein '95 Symposium; the European Resuscitation Council Executive Committee; the Emergency Cardiac Care Committee of the American Heart Association; the Executive Committees of the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa; and several outside reviewers. The development of this statement was authorized by the Science Advisory and Coordinating Committee of the AHA and the Executive Committee of the European Resuscitation Council.

We do not know the true effectiveness of in-hospital resuscitation. Observed results of the many published studies vary greatly. Studies originate from different settings and have different patient populations. Reports suffer from nonuniform nomenclature and variable inclusion definitions. Patients differ in the extent of comorbid conditions and interventions in place at the time of cardiac arrest. These differences prevent valid interhospital and intrahospital comparisons and make determining the effectiveness of current resuscitation techniques impossible.

To develop these guidelines the task force used a consensus development process that originated with the "Utstein style" for reporting outcome data from out-of-hospital resuscitation events. Task force members performed an integrated review of published studies. An initial draft was prepared, discussed, and revised at a 2-day conference. Further drafts were revised and circulated among task force members and discussed face-to-face at three subsequent meetings.

The task force defined a set of data elements that are essential or desirable for documenting in-hospital cardiac arrest. Data categories are hospital variables, patient variables, arrest variables, and outcome variables. The "In-Hospital Utstein-Style Template" was developed to summarize these data and recommendations for reporting a specific set of survival rates and outcomes. The task force recommends that four critical

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"Recommended Guidelines for Reviewing, Reporting, and Conducting Research on In-Hospital Resuscitation: The In-Hospital 'Utstein Style' " was approved by the American Heart Association Science Advisory and Coordinating Committee in December 1996.

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intervals be included, whenever possible, in all reports of in-hospital resuscitation: collapse to cardiopulmonary resuscitation (CPR), collapse to first defibrillation, collapse to advanced airway management, and collapse to administration of first resuscitation medications. The task force also developed the Utstein-style "Standard Reporting of In-Hospital Cardiopulmonary Resuscitation" form, which hospitals can use to record cardiac arrest data for individual patients.

Collection of the recommended variables will enable intrahospital and interhospital comparisons and support national and international research. Collection and review of these data should improve patient care and event documentation for individual patients and reduce medical-legal risks. These recommendations, however, are only a beginning. Definitive recommendations for in-hospital resuscitation require additional research. CPR remains a dramatic medical intervention with both indications and contraindications. Resuscitation activities must be conducted ethically, with concern for the principles of patient self-determination and death with dignity and for the sensitivities of family and friends.

Background

Growth of Resuscitation Activities

Since the rediscovery of the effectiveness of closed chest compression in 1960, medical personnel have made CPR one of the most frequently performed medical interventions in the world. Organizations such as the AHA, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa have developed practical clinical guidelines for emergency cardiac care.

The Emergency Cardiac Care programs of the AHA and equivalent training programs teach techniques of basic life support (BLS) and advanced life support (ALS) to both in-hospital and out-of-hospital emergency personnel. These programs serve to encourage citizen CPR. Versions of these programs have spread to most communities and hospitals in the developed world. Training equipment, educational materials, and personnel costs associated with this training represent more than a billion dollar "industry" in the United States alone.[1] The resuscitation councils of many countries have implemented similar programs and are establishing training networks to ensure that hospital professionals learn and can use recommended procedures.

In the United States hospital accreditation requirements specifically mandate that hospitals develop a planned response to in-hospital cardiac emergencies. Most accredited US hospitals require that medical and nursing staff who respond to cardiac arrests be trained in BLS and advanced cardiac life support (ACLS). This requirement has encouraged the growth of a large emergency cardiac care training industry in the United States. Many hospitals in Europe, Australia, Canada, and South Africa, as well as in countries outside these areas, have mandated or plan to establish similar programs.

In addition, resuscitation is an active and growing subject of academic inquiry. Throughout the world researchers seek the most effective interventions and techniques to resuscitate people after cardiopulmonary emergencies. The journal *Resuscitation* publishes reports of such research, and other major medical journals devote considerable attention to resuscitation topics.

Nevertheless, the true effectiveness of many aspects of resuscitation remains unknown despite the huge investment of scientific and healthcare resources.[2-9] For example, we do not know the value of antiarrhythmic or adrenergic agents given for cardiac arrest,[9-11] nor do we know the true effectiveness of training programs in emergency cardiac care.[3,12] How well do people learn, and can they remember what they learn?[5] Will they perform these skills in a true emergency?[4,13,14] Although several investigators have observed that the quality of resuscitation attempts in terms of objective process criteria improve after formal CPR training,[6-8] significant differences in the critical outcome of survival rates have not been recorded. Finally, it is not firmly established that the correct use of resuscitation protocols, even by formally trained emergency personnel, influences patient outcome.[2]

During the late 1980s and early 1990s, resuscitation researchers began to systematically examine the effectiveness of current resuscitation procedures.[15] The International Liaison Committee on Resuscitation has sought to evaluate available scientific data related to resuscitation protocols.[16] A continuing scientific review of animal and human resuscitation research has led investigators to ask whether the data justify changes or additions to the clinical guidelines. This effort is an attempt to remove anecdotal evidence, subjective impressions, and proclaimed affirmations from resuscitation protocols.

This critical review has been sobering. Few resuscitation interventions are based on valid scientific data. Proper randomized, controlled clinical trials focused on sudden cardiac death, and unexpected resuscitations are difficult, if not impossible, to perform. Many existing resuscitation practices are driven by pathophysiological and nonquantitative reasoning rather than by evidence-based medicine. Resuscitation guidelines often present "best guesses" rather than authoritative conclusions.

Results From In-Hospital Resuscitation Efforts: Variations in Reported Success

For more than 30 years researchers have published many studies on survival after in-hospital CPR. Until recently no clear picture of success had emerged. Three major reviews of more than 50 published articles on survival after in-hospital CPR have demonstrated wide variations in survival.[17-19] McGrath[17] calculated survival rates of 38% at 24 hours (range 13% to 59%) and 15% at hospital discharge (range 3% to 27%). DeBard[18] reported survival rates of 39% at 24 hours and 17% at discharge to home. Cummins and Graves[19] reviewed 44 studies and calculated survival rates to hospital discharge that ranged from 3% to 27% following an in-hospital cardiac arrest. Such wide variations in the rate of survival are explained largely by marked differences in inclusion criteria and outcome definitions.

Two large-scale projects provide the best evidence on success of in-hospital resuscitation. The Belgian Cardiopulmonary Cerebral Resuscitation Registry (BCCRR), working with the European Resuscitation Council, gathers information on survival from both in-hospital and out-of-hospital resuscitation.[20,21] In the British Hospital Resuscitation Study (BRESUS), investigators analyzed the results of 3765 attempted cardiopulmonary resuscitations in 12 teaching and nonteaching hospitals throughout the United Kingdom.[22] Neither of these projects, however, is exclusively focused on in-hospital resuscitation. In BRESUS 25% of patients experienced onset of arrest during the prehospital phase. Investigators observed that 39% of patients survived the immediate arrest, 28% were alive 24 hours later, 17% were discharged from the hospital, and 12.5% survived for 1 year. Both BRESUS and BCCRR helped pioneer standard methods of recording arrests for audit, clinical trials, and community studies. These studies provide a yardstick for comparing results from selected UK and Belgian hospitals with those obtained in other countries and for helping assess the effect of subsequent management changes.

Origin of the Utstein Style and Extension to In-Hospital Arrests

The Utstein style for reporting cardiac arrests arose from a 1990 conference at the ancient abbey of that name on an island near Stavanger, Norway. That conference and another later that year were attended by representatives of the AHA, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council. The results of these meetings have been previously reported.[23-30] The major concern was that the results of resuscitation endeavors in different countries, and even within countries, could not be compared meaningfully. Researchers have used disparate end points to assess the effectiveness of different systems and interventions. Useful comparisons have been prevented by this lack of uniform definitions and standard methodologies.

The Utstein style has attracted wide interest and has become a familiar term among members of the resuscitation community. Many researchers and system directors have adopted the Utstein templates, style, and nomenclature to report results of prehospital resuscitation. The success of this international initiative soon led to uniform international styles for reporting the results of pediatric resuscitation[31] and experimental (laboratory) resuscitation.[32]

This report continues the Utstein style process by including adult in-hospital resuscitation within the international reporting agreements. These guidelines and recommendations can improve the scientific design of research projects and increase the clinical usefulness of published studies.[33] Improved projects and publications will provide consistent and reliable evidence on which to base treatment decisions. Uniform definitions and methodology will support valid interpretations of findings across multiple studies and permit more accurate integrative reviews and meta-analyses of resuscitation studies.

In-Hospital Resuscitation

In-hospital resuscitation presents unique challenges for research and evaluation. In 1990 the original Utstein Task Force considered including in-hospital resuscitation in the uniform guidelines[24] but postponed doing so because of its daunting complexity. Critical problems needed to be resolved: inconsistent definitions used in the description of resuscitation emergencies and outcomes, comorbid factors and severity adjustments for the victims, and the effects of interventions already in place at the time of arrest.

A cardiac arrest is defined in the Utstein style as "the cessation of cardiac mechanical activity ... confirmed by the absence of a detectable pulse, unresponsiveness, and apnea (or agonal respirations)."[24,30] A hospital patient, however, may have many degrees of cardiac and pulmonary dysfunction that cannot be characterized as cardiac arrest, such as hypotension or shock. A patient's respiratory status can range from normal to agonal or gasping breaths to apnea, or the patient may be on artificial ventilation.

A hospital patient needing resuscitation could have comorbid conditions that may or may not influence resuscitation outcome. For example, comorbid conditions could be unrelated to resuscitation outcome (eg, hysterectomy for uterine fibromas), moderately related (eg, acute pneumococcal pneumonia), or strongly related (eg, acute pulmonary edema after myocardial infarction). Moreover, comorbid and preexisting conditions may vary greatly in severity; for example, acute pneumococcal pneumonia may vary greatly in extent of organ involvement and in severity. Almost every publication on in-hospital resuscitation has neglected to allow for the magnitude of comorbid conditions.

In-Hospital Utstein Variables

To improve reports of in-hospital resuscitation, the Utstein Task Force identified four sets of variables that required further definition: hospital variables, patient variables, arrest variables, and outcome variables (Fig 1).

No hospital, researcher, quality improvement advocate, or process evaluator will be able to collect all of these variables. Much of the data discussed will be collected only for specific purposes. For example, resuscitation attempts are critical events in the care of a patient that should be recorded as a vital part of the patient's medical record. Often these data

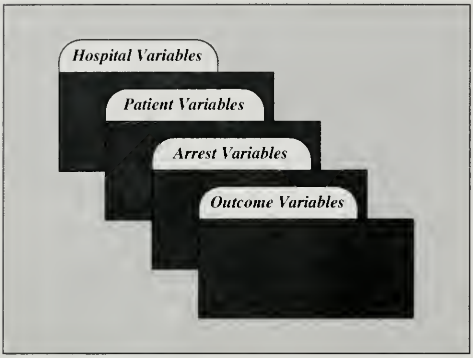

Fig. 1. Four major categories of variables for documenting in-hospital resuscitation.

are recorded incompletely and inaccurately in the rushed turmoil of in-hospital resuscitation. The minimum data elements related to individual resuscitation attempts that should be collected are defined.

Outcome measurements for interhospital or intrahospital comparisons or specific research projects require a description of the context of the resuscitation. This context includes hospital variables as well as patient variables. Definitive evaluation of resuscitation efforts requires measurement of outcome variables, either immediate, intermediate, or long term. Outcome evaluations, however, require following the patient outside the hospital, a task that requires a large amount of time, energy, and personnel resources.

Patient Variables

Table 1 lists the patient variables that the task force recommends be reported. In selecting the required variables, the task force sought to include variables for which there is evidence of an association with differences in survival rates. Table 1 defines these variables and provides directions or comments for their use. Many of these variables are self-explanatory and descriptive. The definitions and directions for some variables are expanded below.

Age. Some studies have linked older age to poor outcome following out-of-hospital cardiopulmonary arrest and resuscitation.[34-37] In other studies, however, age alone was not shown to be an independent determinant of survival.[38-47] The observed differences in the effect of age on out-of-hospital and in-hospital arrest survival are difficult to separate from the effects of comorbid conditions.[47]

Age categories should, at a minimum, separate pediatric data from adult data and should stratify the adult population. Adolescents are a difficult group to classify.[14-19] Studies on the incidence of ventricular fibrillation (VF) in various age groups, for example, have yielded conflicting results. These differing results stem, in some degree, from whether to group adolescents with adults or children.[48-52] The context of the study determines the designation: adolescents may be included in pediatric studies provided they are separated from younger children or in adult studies provided they are separated from older adults. Because no single age is consistently used to separate children from adults, the following age categories and subsets (the convention is that the year of age advances on the exact anniversary of birth) are recommended:

- Infant: 0 to 12 months
  Report the following age subsets:
  - 0 to 30 days
  - 31 days to 12 months
- Child: 1 to < 20 years
  Report the following age subsets:
  - 1 to < 3 years
  - 3 to < 8 years
  - 8 to < 14 years
  - 14 to < 20 years
- Adult: 20 years and older
  Report the following age subsets:
  - 20 to < 25 years
  - 25 to < 35 years
  - 35 to < 45 years
  - 45 to < 55 years
  - 55 to < 65 years
  - 65 to < 75 years
  - 75 to < 85 years
  - 85 and older

Gender. Researchers have paid increasing attention to the role of gender in cardiovascular disease in terms of risk factors,[53,54] outcomes,[53-59] and treatment differences.[60-66] The task force recommends recording the gender of all patients.

Witnessing and Monitoring of Event. Witnessed cardiac arrests are those that are seen, heard, or monitored. All witnessed arrests should be further classified as monitored (more often in intensive care units [ICUs] or telemetry units) or unmonitored (more frequently in locations that involve less critical care) because monitoring is likely to influence other patient variables. Patients whose cardiac arrests are not witnessed have markedly reduced chances of successful resuscitation and should be considered separately.

Location of Event. In view of the differences in case mix and likely response interval in different areas of the hospital, documentation of the patient's location at the time of cardiac arrest is considered an essential patient variable. Table 1 lists recommended location categories.

Table 1. In-Hospital Resuscitation Data: Recommendations for Information to Report on Individual Patients*

Data Element	Definition	Priority	Directions or Comments
Patient variables			
Patient name (collect for medical record, not data reports)	Someone who occupies a hospital bed; no duration of occupancy required (eg, > 24h).	Essential	Tabulate separately outpatients who have events inside the hospital and patients who have events in-hospital but whose original arrest was outside the hospital. Patient confidentiality must be respected in all data acquisition and reporting.
Patient identifier	Allows tracking of all hospital and subsequent audit records.	Essential	In US, social security number recommended; may be hospital number. Patient confidentiality rules must apply.
Date of birth	Self-explanatory	Essential	Record as dd/mm/y.
Date of admission	Self-explanatory	Essential	Record as dd/mm/y.
Age	Self-explanatory	Essential	Record as years and months/12 for patients < 21 y.
Gender	Self-explanatory	Essential	Record as male, female, unknown.
Height	Self-explanatory	Essential	Record in metric scale. Essential for infants and children.
Weight	Self-explanatory	Essential	Record in kilograms. Essential for infants and children.
Witnessing/ monitoring of event	Resuscitation emergency was seen, heard, or monitored.	Essential	Record as yes, no, or unknown. For yes, indicate whether is was monitored or unmonitored.
Location of event	Area of hospital where event was recognized.	Essential	Record as general care floor, emergency department, operating suite, intensive care unit, coronary care unit, postanesthetic recovery area, diagnostic or treatment unit, outpatient evaluation unit, or other in-hospital area.
ALS interventions in place at time of event	Interventions in place and available at time of event.	Essential	Record the following: endotracheal intubation, mechanical ventilation, IV access, intra-arterial catheterization, IV medications, and implantable defibrillator-cardioverter.
Previous cardiopulmonary events	Location and number of previous full cardiac events that required resuscitation attempts; previous events must have occurred > 24 h before index event.	Desirable	Record the number of previous cardiac events in the following categories: out-of-hospital; in-hospital, prior admissions; in-hospital, same admission (only if > 24 h before index arrest).
Reason for admission	Full clinical details and diagnoses may not be immediately available to the event team. Summary categories can be used.	Desirable	Record as cardiac (medical and surgical); noncardiac, medical; surgical, procedural (scheduled/elective, scheduled/nonelective, or nonscheduled/emergent); or trauma, multiple reasons.
Preevent functional capacity	Use CPC score based on chart review, family or staff interviews, and information recorded at admission.	Desirable	See detailed definitions of CPC score under "Outcome variables" below. Use pediatric modifications for patients < 18 y.[31]
Comorbid conditions	Major medical and surgical conditions present at time of event and judged most related to event.	Desirable	Record major ICD-9-CM codes entered in medical record attestation sheet or discharge/transfer or death summary. Indicate whether autopsy was performed, and record major cause of death, using autopsy information or death certificate.
Event variables			
Immediate precipitating cause	Immediate trigger for cardiorespiratory event.	Essential	Record as lethal arrythmia, myocardial ischemia/infarction, hypotension, respiratory depression, metabolic, other, or unknown. The immediate trigger may be uncertain.
Resuscitation attempted	Airway interventions, chest compressions, defibrillation, or DNAR status.†	Essential	Indicate yes or no (template boxes 2 and 3). If yes, list all of the following possibilities used: airway only, defibrillation only, chest compressions only, or combination interventions. If no, indicate whether patient was found dead; resuscitation attempt considered futile, or DNAR order existed.
Initial resuscitation condition	Condition of patient at time of arrival of first healthcare professional.	Essential	Record yes or no for presence of apnea, pulselessness, and unconsciousness.
Initial rhythm	First monitored cardiac rhythm recorded after call for help.	Essential	Record at VT/VF, asystole, pulseless electrical activity, bradycardia, or normal perfusing rhythm (template boxes 5 and 6).
Method to time events and intervals	Audit forms should use 24-h clock time. An interval is the duration of time between timed events.	Essential	Establish hospital-wide synchronization of clocks. Defibrillator clock can and should be standard synchronization clock for all interventions during resuscitation effort.

Table 1. Continued

Data Element	Definition	Priority	Directions or Comments
Time collapse noted	Time at which victim was seen or heard to collapse.	Essential	For patients on telemetry, onset may be evident from telemetry monitor; however, resuscitation cannot begin until patient is physically located. Hence, this is the time to be recorded for audit purposes.
Time CPR team called	Time of call to hospital switchboard to mobilize cardiac event team.	Essential	A listing of all cardiac event calls should be kept by the hospital switchboard and audited against return of cardiac event report forms on a monthly basis.
Time CPR team arrives	Time of arrival of personnel specifically responsible for performing resuscitation.	Essential	Does not apply in settings where specific event teams do not exist. In emergency department, eg, team is constantly present.
Time arrest confirmed	Best estimate of time of professional confirmation of absence of central pulse.	Essential	Normally confirmed by first healthcare professional at the scene of the event.
Time CPR started	Time of first chest compressions.	Essential	Record provider of first CPR for audit purposes. Record as nurse, clinical assistant, physician, respiratory therapist, or other.
Time CPR stopped	Time chest compressions stopped, not to be resumed; represents either time of death or time of ROSC.	Essential	Most forms with resuscitation matrixes allow space to record that CPR was stopped and started multiple times during "stuttering" events. In Utstein style, multiple starting and stopping is unnecessary; report only final events.
Time of first defibrillatory shock	Time of first and all subsequent defibrillations should be recorded.	Essential	Newer defibrillators, especially shock advisory devices, possess event documentation capabilities that facilitate recording this information.
Time advanced airway achieved	Time of achievement of advanced airway management (not when first attempt is made).	Essential	Advanced airway management includes endotracheal intubation or alternative airway strategies (laryngeal mask airway or esophageal obturator airway).
Time of first IV dose of medication	Time of completion of administration of first dose of epinephrine, adrenaline, or other medication.	Essential	The time, dose, and route of administration of all drugs should be recorded.
Time of ROSC	Return of any palpable central pulse in the absence of ongoing chest compressions. When intra-arterial BP recording is present, a systolic BP $\geq$ 60 mm Hg is equivalent to a palpable central pulse.	Essential	Record time ROSC was achieved. Record as yes, never achieved, or achieved but not sustained (template box 9).
Time of end of ROSC	Applies to patients who have unsustained ROSC or who died in hospital.	Essential	Categorize as never achieved, $\leq$ 20 min; > 20 min but $\leq$ 24 h; or > 24 h (template box 9).
Outcome variables			
Date and time of in-hospital death	Applies to patients with ROSC > 24 h.	Essential	Allows calculation of length of hospital stay and hospital survival after ROSc; not applicable for patients who survive to be discharged from hospital (template box 9).
Predeath status	After arrest, clinical status of patients who have ROSC may be reclassified.	Desirable	Record as not applicable (patient survived to discharge), full resuscitation status, changed to DNAR, support withdrawn after ROSC, declared brain dead, or referred for organ donation (template box 9).
Date and time of hospital discharge or transfer	Self-explanatory	Essential	Allows calculation of length of stay for successfully resuscitated patients. Record as not applicable (patients not resuscitated or died in hospital) or dd/mm/y (template box 10).
Glasgow Coma Score		Essential	Record every 24 h after ROSC, at time of discharge until stable, at 6 mo and at 1 y. For patients who die in hospital, record best achieved. Record separate scores for eye-opening response to speech and pain (1–4), verbal response to speech and pain (1–5), and motor response to voice commands and painful stimuli (1–6). Note that eye opening (3–4), verbal response (6), motor response (5) constitutes "awake" (see time of awakening).

Table 1. Continued

Data Element	Definition	Priority	Directions or Comments
CPC	.	Essential	Record separate score for 5 components. Record at time of discharge, 6 mo, and 1 y. For patients who die in hospital, record best CPC achieved. 0 = NA, not discharged alive. 1 = Good cerebral performance. Conscious, alert, able to work and lead a normal life. May have minor psychological or neurological deficits (mild dysphagia, hemiparesis, or minor CNS abnormalities). 2 = Moderate cerebral disability. Conscious, sufficient cerebral function for part-time work in sheltered environment or independent activities of daily life (eg, dressing, traveling on public transportation, preparing food). May have hemiplegia, seizures, ataxia, dysarthria, dysphagia, or permanent memory or mental changes. 3 = Severe cerebral disability. Conscious, dependent on others for daily support because of impaired brain function (ie, lives in an institution or at home with exceptional family effort). At least limited cognition; includes a wide range of cerebral abnormalities from independent existence to paralytic and able to communicate minimally. 4 = Comatose, vegetative state. Not conscious; unaware of surroundings, no cognition; no verbal or psychological interactions with environment. 5 = Brain death/organ donation candidate
Time of awakening	Patient is considered awake if he or she responds appropriately to commands makes spontaneous verbal statements, makes appropriate eye contact, makes appropriate motor responses, or appears conscious and oriented.	Essential	Record as interval, in hours, from arrest to awakening. An interval of 6–24 h may be used when awakening event is imprecise.
Alive at 6 mo, at 1 y	Self-explanatory	Essential	Record as yes (only if confirmed by reliable means,) no, or unknown.
Date of death after hospital discharge	Applies to patients who are discharged alive from hospital.	Essential	Allows calculation of length of survival. Record as still alive, survival status unknown (dd/mm/y) (template boxes 11 and 12).
Principle cause of death	Applies to patients who die after discharge.	Essential	Record as cardiac, other medical, trauma, or other. Add ICD-CM-9 codes when possible. Indicate source of information for cause of death (medical records, death certificate, autopsy, persona physician, or other) (template box 12).
Immediate mechanism of death	Applies to patients who die after discharge.	Essential	Record as sudden cardiac death, acute myocardial infarction, CHF, CVA, other medical, trauma, other, or unknown (template box 12).
Audit of resuscitation attempt	Self-explanatory	Desirable	To assess quality of resuscitation attempt, review time of team arrival, time of equipment arrival, equipment function, team leadership, and task performance. The audit form can be developed as a separate form used for quality-assessment purposes and therefore does not become part of the patient's medical record. Data items can be phrased as yes or no questions; space should be allocated for comments on problems experienced during resuscitation.

ALS indicates advanced life support; BP, blood pressure, CHF, congestive heart failure; CNS, central nervous system; CPC, Cerebral Performance Category; CPR, cardiopulmonary resuscitation; CVA, cerebrovascular accident; DNAR, do not attempt resuscitation; ICD-9-CM, International Classification of Diseases, 9th ed; IV, intravenous; ROSC, return of spontaneous circulation; and VT/VF, ventricular tachycardia/ventricular fibrillation.

*See Fig 5 for an example form incorporating these recommendations.

†A directive was entered into the medical record before the event stating that medical personnel should not attempt resuscitation.

Advanced Life Support Interventions in Place at Time of Arrest. Some resuscitation interventions are often instituted before a patient experiences an actual resuscitation emergency. For example, any of the following interventions may be in place when resuscitation begins: monitor and defibrillator, mechanical ventilation, intravenous pressor or inotropic agents, or intravenous antiarrhythmic agents. Survival rates for such a heterogeneous group of patients will likely be affected by the presence of these interventions as well as by the condition of the patients before the emergency. To illustrate, the outcome probability for VF arrest will likely differ markedly for a patient who is intubated and on a ventilator compared with a patient without special surveillance in a general ward. Table 1 describes a number of interventions that should be noted if present at the time of arrest.

Previous Cardiopulmonary Arrest. Survival of a recent cardiac arrest constitutes a significant comorbid condition for future arrests and resuscitations. Recommendations on how to analyze patients who have had multiple arrests and have undergone previous resuscitations are discussed in the section on template box 9.

Reason for Admission. The task force recommends placing patients into several categories on the basis of the major reason for hospital admission (Table 1). These categories provide information on significant comorbid conditions that would otherwise confuse the results of resuscitation attempts. For example, patients hospitalized for medical reasons tend to have different causes of arrest and different resuscitation outcomes than patients admitted for surgery or out-of-hospital trauma.

Prearrest Functional Capacity. Resuscitation outcomes can be evaluated only by comparing postresuscitation status with prearrest status.[67] A simple, validated tool for this purpose is lacking. The formal tools that can be used after the arrest are almost never applied before arrest. Furthermore, the optimal timing of the prearrest evaluation of function is unclear: should the level of function be recorded immediately before the arrest, at the time of admission, or at some time before admission?

The Glasgow-Pittsburgh outcome categories, including the Glasgow Coma Score,[68-70] the Cerebral Performance Categories (CPCs), and the Overall Performance Categories (OPCs)[71,72] are the most widely used tools to evaluate functional outcome following resuscitation in adults. Numerous out-of-hospital studies have followed the recommendations of the Utstein style in this respect.[73] These categories were modified and validated for use in children.[74] They appear sufficiently broad so that the required information may be reliably derived from retrospective chart review, although this has not been confirmed. The task force recommends some attempt to record, through chart review or patient or family interview, the CPC and the OPC (using pediatric modifications if appropriate) at the time of hospital admission.

Comorbid Conditions. Comorbid conditions have a powerful influence on the outcome of patients treated for out-of-hospital VF.[75] A comorbidity index derived from a medical history of 10 chronic conditions, medication use, and recent symptoms was strongly linked to survival.[75] Only one published study of in-hospital arrest patients considered these comorbid conditions.[47] Nevertheless, the task force recommends recording the presence of major comorbid conditions. The likelihood that these comorbid conditions will strongly influence resuscitation outcomes possesses a high degree of face validity. No single validated method exists to describe comorbidity in hospitalized patients. Although this is an important area for future research, the issue of comorbidity cannot be ignored while awaiting future studies. The task force recommends using the International Classification of Diseases, ninth edition (ICD-9-CM), to describe comorbid conditions. Because ICD-9-CM coding is completed only at discharge or death of the patient, care must be taken to include only the major ICD-9-CM codes present before the arrest.

The ICD-9-CM codes, however, have limitations. In many hospitals ICD-9-CM codes and discharge and diagnosis data (often collected for insurance purposes) are generated more to calculate hospital charges than to document patient diagnoses.[76,77] These codes consist of a heterogeneous group of conditions, including diagnoses, pathological processes, symptoms, physical findings, test findings, and severity indicators. The "correct" coding may vary among providers, institutions, or regions. Researchers need some method to group ICD-9-CM codes to enable meaningful comparisons of outcomes between population subgroups. The BRESUS investigators used eight groupings of ICD-9-CM codes to classify a large number of ICD-9-CM codes.[22] This grouping may be useful, although others may be valid.

Severity Estimates. The severity of a patient's prearrest condition may certainly affect clinical outcome. No simple, validated severity classification system is appropriate for both ICU and non-ICU patients. The Utstein Task Force considered a number of existing severity classification systems. The Acute Physiology and Chronic Health Evaluation (APACHE II or III) scoring system for patients in the ICU[78-80] is used in many critical care units, but it is complex and designed solely for ICU patients. Some research has addressed the problem of predicting failure to survive after in-hospital CPR.[41,81-84] The Pre-Arrest Morbidity (PAM) Score includes comorbidity factors but has been validated only as an instrument to predict outcome following cardiac arrest.[83,85] The Prognosis-After-Resuscitation (PAR) Score has fewer variables than the PAM score and in Ireland was better at predicting patients unable to survive in-hospital resuscitation.[84] The Therapeutic Intervention Scoring System (TISS)[86,87] and the modified TISS (for non-ICU patients) are limited because they reflect more the therapy provided than the severity of the patient's illness. The various revisions of the New York Heart Association functional classification are too nonspecific and broad.[88] At this time the task force recommends use of the most appropriate validated severity classification system for the population studied.

Other arrest data, including location (ICU versus ward) and concurrent therapeutic interventions (eg, mechanical ventilation or administration of vasopressors) (see below) may provide some surrogate information to suggest the severity of illness. Research is necessary to establish whether these proxy measures are valid surrogates for classification of severity.

Race/Ethnicity. Several research projects have identified a powerful association between race and the incidence of bystander CPR,[89] outcomes of cardiovascular disease,[90-92] survival of out-of-hospital sudden cardiac arrest,[93,94] and survival following in-hospital CPR.[95] The outcome of resuscitation attempts for some ethnic groups may be influenced by additional factors such as socioeconomic status,[96,97] inequalities in access to health care, utilization of health care, or provision of health care.

The task force recognized major differences in the categories for expressing race among countries. The racial mix of patients in different countries varies significantly, and no common list of racial categories that applies to all countries can be specified. Any group accounting for only a small proportion of a study population will seldom produce data that can be analyzed meaningfully. The task force therefore recommends that researchers specify only those minorities or ethnic groups that make up a significant proportion of the total population of a study.

Socioeconomic Status. Some researchers have found an association between lower socioeconomic status and lower rates of survival of out-of-hospital cardiac arrest.[97,98] Researchers have used a variety of measures of socioeconomic class in other epidemiological research, none of which are internationally accepted. The task force does not recommend a single measure of socioeconomic status to collect but considers this an interesting area for future research.

Event Variables

The major event variables that should be recorded are rhythms, interventions performed, event times, and event intervals.

Rhythms. The task force recommends grouping arrest rhythms into two major categories: VF/pulseless ventricular tachycardia (VF/VT) or non-VF/VT.[15,16] Non-VF/VT can be subclassified as either pulseless electrical activity (PEA) or asystole. These rhythms are defined in template boxes 5 and 6.

Interventions. Essential interventions that should always be recorded if performed include the following:

- Defibrillation
- Insertion of an artificial airway, specified by type (eg, endotracheal tube or laryngeal mask)
- Drugs, including antiarrhythmic agents and vasopressors
- Pacing, specified by type (eg, external or internal)
- Mechanical circulatory assist devices (eg, balloon pump or cardiopulmonary bypass).

Event Times and Event Intervals. Table 1 provides definitions and directions for the recommended variables. All of the following event times are essential and should be recorded if relevant and available:

- Time of collapse (event onset)
- Time of call for help
- Time of arrival of CPR team
- Time of confirmed cardiac arrest
- Time CPR started
- Time CPR stopped
- Time of first defibrillatory shock (and all subsequent shocks)
- Time of advanced airway management (including intubation)
- Time of first dose of intravenous epinephrine/adrenaline and all other resuscitation medications
- Time of any return of spontaneous circulation (ROSC) and of sustained ROSC
- Time of end of ROSC
- Time of abandonment of resuscitation attempt

Lack of clock accuracy and synchronization can be a major problem in resuscitation research.[99-101] Hospitals should synchronize the clocks used in resuscitation records to a single time source. Current defibrillator models provide time annotations on monitor strips; therefore, the defibrillator is the best source for clock synchronization.

From the recorded event times a variety of intervals (time elapsed between two events) can be calculated. The following intervals are recommended as the gold standard process variables for interhospital and intrahospital comparisons:

- Interval from event onset to start of CPR
- Interval from event onset to first defibrillation
- Interval from event onset to advanced airway management
- Interval from event onset to first administration of resuscitation medication

Other clinically important intervals include the following:

- Interval from event onset to ROSC (palpable spontaneous pulse)
- Interval of sustained ROSC
- Interval from event onset to CPR stopped

Outcome Variables

Resuscitation aims to return patients to their level of health before the cardiac arrest. Resuscitation outcome can be expressed in one or more of three domains: survival (did the patient live?), longevity (how long did the patient live?),[70,102,103] and quality of life (how well did the patient live?).[104-106] Survival can be subdivided further using a time dimension, such as immediate (ROSC), short term (discharged alive from the hospital), or long term (6 to 12 months).

Quality of Life as an Outcome. Quality-of-life outcomes reflect the widely accepted concept that health is not just the absence of disease and infirmity but also the presence of physical, mental, and social well-being.[107] Assessment of quality of life as an outcome requires reference to physical, psychological, and social domains of health. These domains are measured as either objective assessments of functioning or as subjective perceptions. The rich interaction of objective functioning and subjective perceptions determine the overall quality of life for an individual. Two people with the same results on objective measures of health may have profoundly different estimates of quality of life.

Functional Outcomes. Although many valid functional assessment instruments have been developed, no single approach applies to all patients. The Glasgow Coma Score, introduced and validated for neurological assessment following trauma, is a simple-to-record, reproducible assessment of consciousness.[70] The three individual components of the 15-point score (motor response, verbal response, and eye opening) are recorded separately, then in total, 24 hours after the initial event. The motor component is best associated with outcome, particularly if the score is recorded daily over time.[108,109] Recording of brain stem reflexes may add additional predictive value.[110]

The CPC score is one of several instruments developed to assess cerebral performance outcomes following both traumatic and anoxic cerebral injuries.[71,72] This score approaches a disease-specific instrument because survival of cardiac arrest constitutes survival of a transient, global cerebral ischemic or anoxic event. The CPC score has been used to evaluate outcomes in several studies of cardiac arrest survivors.[105,111-115] However, its use as a single measure of neurological outcomes in cardiac arrest survivors has been strongly criticized.[116] Hsu et al[116] noted that in a small group ($n = 35$) of cardiac arrest survivors, the CPC score correlated poorly with subjective quality-of-life assessments and results of validated objective functional testing instruments. An additional useful measure of minimum neurological outcome is the time to awakening or return of consciousness.[117]

As minimum uniform assessments, the task force recommends recording the time to awakening and the serial Glasgow Coma Scores in the immediate postarrest period. These measures will document either return of consciousness or persistence of various levels of the coma state. In addition, the CPC should be recorded at hospital discharge and again 6 months to 1 year after the event. The Utstein Task Force recognizes the limitations of the CPC score and that use of multiple standardized testing instruments is superior.[106,118] The CPC score has the appeal of simplicity and practicality.

For patients who die between hospital discharge and 1 year after the arrest, the best functional status during that year should be recorded if it is available and practical to obtain. Recording the best functional status is recommended because a subsequent decline in functional outcome after initial improvement may be unrelated to the arrest. For example, premorbid conditions may affect eventual outcomes more than the arrest episode itself.

Additional Outcome Assessments. Length of stay (days of hospitalization) after resuscitation is a useful variable to record. Length of stay can help answer questions about the value of in-hospital resuscitation because a number of studies have documented prolonged hospital stays after resuscitation.[114,119,120] Patients may be resuscitated from a cardiac arrest but condemned to live many weeks in a severely compromised state, requiring costly intensive care. Serious cost-benefit concerns arise when compromised patients die after prolonged hospital stays, not to mention the pain and suffering experienced by the patient and family members.

Cost data have not been included in many publications on resuscitation.[114,121,122] The cost-effectiveness of interventions such as CPR and resuscitation, however, must be evaluated. Investigators should measure costs rather than charges because costs better represent the societal burden of an intervention such as CPR.[123] The cost benefit of in-hospital resuscitation may be expressed as the cost per survivor to hospital discharge or the cost per quality-adjusted life-year. Calculation of total costs includes the costs of resuscitation, stay in the ICU, stay in the ward, and subsequent nursing home or home health costs. An increase in survival rates will result in lower costs per survivor. The value of this information may be severely limited by economic factors such as inflation, profitability issues, cost shifting, reimbursement policies, and variable national approaches to healthcare financing.

If the patient is discharged, researchers may record the discharge destination: home (or preevent residence), rehabilitation facility, extended-care facility (nursing home), another acute care hospital, or other. Although discharge destination is often used as a surrogate for neurological outcome, researchers should record the need for home nursing care because discharge to home may not necessarily represent a good outcome.

Hospital Variables

Hospital variables are required for interhospital comparisons because the setting of an arrest influences resuscitation capabilities and outcome data. However, no widely accepted categorization of hospital variables exists. Many variables are independent factors that may affect outcome. Table 2 provides a checklist of information to include on reports of in-hospital resuscitation. The task force declined to recommend any of these variables as essential because the effect of any of these on arrest outcomes is speculative. Additional research and publications will provide better guidance.

Utstein Template for Reporting Data From In-Hospital Resuscitation

Template Concept: What It Represents, How to Use It

The Utstein style was created for reporting out-of-hospital cardiac arrest.[24,30] The centerpiece of that work was a template for uniform display of outcomes. This template, although now used widely, is not always used correctly. The template concept is based on the following principles:

- The initial boxes of the template define a population; this population must be accounted for in subsequent boxes of the template.
- The number of each box serves both as the numerator for the box above it and as the denominator for the box below it.
- The template displays a central "trunk," which is considered the most important subpopulation to report.
- Depending on the objectives of the study, several branches can be identified and analyzed, analogous to a hierarchical filing system or pull-down menus in the organization of computer files.
- Although numerous branches of the algorithm can be developed, in most instances this is not necessary.
- Concerns about sample size will necessitate combining rather than splitting population subsets. Investigators should make clear which subsets are being considered and which have been combined or subdivided.

Template Boxes (Fig 2)

Template Box 1: In-Hospital Patients With a Pulse: This template box provides the conceptual starting point to analyze resuscitation results obtained in a hospital. Researchers do not need to determine this exact number because it is not required for later outcome calculations. This population is analogous to the "population served" in out-of-hospital statistics.[24,30] Any patient arriving at the hospital with a spontaneous pulse becomes a candidate for later resuscitation attempts. Include all patients who occupy a hospital bed. No minimum stay, such as more than 24 hours, is recommended. Include patients who experience an arrest in the emergency department or casualty suite.

Exclude from analysis (or report as separate subsets if these patients represent an area of particular interest) persons brought to the hospital for pronouncement of death and persons who do not occupy a bed, such as outpatients or clinic attendees who suffer a cardiac arrest inside the hospital. Finally, report separately persons who originally had an arrest outside the hospital and were brought to the emergency department after ROSC or with continuing CPR. These patients more properly belong in the original out-of-hospital template.

Template Box 2: Cardiac Arrest, No Resuscitation Attempted:

- Patients designated as DNAR
- Patients not designated as DNAR
- Found dead
- Considered futile

Some patients, for reasons of self-determination, living wills, advance directives, or medical indications, should not receive attempted resuscitation. Most hospitals have mechanisms to identify these patients. These patients do not belong in a denominator for calculating in-hospital survival rates and should be separated from the main branch of the template.

The task force endorses use of the term "do not attempt resuscitation" (DNAR). It is inappropriate and misleading to use a term such as "do not resuscitate," which implies to patients, family, and friends that personnel could have resuscitated a patient if they had wished. The term DNAR offers a more accurate assessment of the reality of resuscitation attempts.[124]

It is recognized that there will be additional patients for whom no resuscitation attempts will be made. The two major groups are patients found dead in bed or elsewhere in the hospital and patients for whom the response teams, for a variety of reasons, considered resuscitation efforts futile.

Template Box 3: Attempted In-Hospital Resuscitations:

- Total
- Defibrillation only
- Chest compressions only
- Airway interventions only
- Combination interventions

Any meaningful resuscitation attempt by appropriate healthcare providers qualifies as attempted in-hospital resuscitation (template box 3). Stopping resuscitation efforts because the patient failed to respond to initial ACLS efforts represents an attempted resuscitation. If rescuers inadvertently provided a full resuscitation attempt to a DNAR patient, this is an attempt. If only a momentary attempt was made while personnel confirmed the DNAR status or because of immediate discovery or determination that resuscitation is not indicated, the "no resuscitation attempted" classification should be selected.

Table 2. Checklist of Information To Include in Reports on In-Hospital Resuscitation

Setting

- Care level of hospital (primary, secondary, or tertiary)
- Total number of hospital beds
- Total beds allocated to
  - Intensive care units, coronary care units
  - General or ward
  - Emergency department
- Annual number of admissions

Resuscitation management

- Describe general treatment approach (whether by immediately available personnel or by designated cardiac arrest responders)
- State response origin (whether on-site or from location distant from arrest)
- Describe composition of arrest team, both professional level and treatment capabilities (eg, can nurses perform defibrillation or endotracheal intubation?)
- Describe method for activating arrest response (whether by general broadcast public alert or local audio alert, alerting device carried by response team members)
- List equipment usually available (defibrillators [conventional, automated, or both], endotracheal intubation apparatus, intravenous medications, other)
- Describe type of resuscitation training for response personnel (ACLS training, BLS, defibrillation)
- Describe types of treatments and treatment protocols (eg, are they consistent with AHA/ERC guidelines?)
- List average number of resuscitations attempted each year

Gold standard process intervals

- Record median response intervals from onset of emergency to start of basic CPR
- Record interval from collapse to first defibrillatory shock for patients in VF
- Record interval from collapse to endotracheal intubation
- Record interval from collapse to first intravenous administration of epinephrine

Resuscitation outcomes

- Provide data to allow calculation of the following survival rates:*
  - Percent survival from arrest to successful resuscitation (ROSC > 24 h)
  - Percent survival from successful resuscitation (ROSC > 24 h) to discharge
  - Percent survival from successful resuscitation (ROSC > 24 h) to 1 y
  - Percent survival from arrest to discharge
  - Percent survival from discharge to 1 y
  - Percent survival from arrest to 1 y
- For each survivor alive at 1 y, determine
  - Number of attempted resuscitations
  - Number of initial survivors (ROSC > 20 min)
  - Number surviving first 24 h
  - Number leaving hospital alive
- To adjust for reattempts and rearrests, calculate
  - Percent survival from arrest to discharge per patient with ≥ 1 arrest
  - Percent survival from arrest to discharge per total resuscitation attempts
  - Percent successful resuscitations (ROSC > 24 h) per total resuscitation attempts
- For patients who have ROSC > 24 h, report
  - Median length of hospital stay
  - Median cost and charges (distinctions between hospital costs and patient charges should be appreciated and clarifying statements provided in report)
  - Destination of discharged patients (home, minimal to highly skilled nursing facility, custodial care facility, other)
- For patients who had any ROSC but died in hospital, report
  - Percent declared DNAR
  - Percent who had support withdrawn
  - Percent who had brain death established
  - Percent who had organ donor status declared
- For patients discharged from hospital, report
  - Distribution of survivors within CPCs (percent in level 1, level 2, etc)
  - CPCs for survivors who live ≥ 6 mo
  - CPCs for survivors who live ≥ 1 y
- Time trends
  - Record outcomes listed above on an annual basis and compare changes over time

Table 2. Continued

Ethical considerations
- DNAR status (describe hospital's DNAR policy, eg, are advance directives discussed at admission? who determined DNAR? how are patient wishes identified? can physicians declare DNAR status on the basis of medical futility alone without discussing with patients, family members, or surrogates?)
- Informed consent (describe how informed consent is obtained when resuscitation research protocols exist, eg, are protocols submitted to an institutional review board?)
- Patient confidentiality (describe how patient confidentiality is preserved in review of in-hospital research outcomes, particularly measurements of postresuscitation functional status)
- Organ donation (when relevant, describe hospital policy on resuscitation for organ donation)
- Practicing procedures on the newly dead (report whether hospital personnel are allowed to practice resuscitation procedures on the newly dead; if so, describe hospital policy and whether consent is obtained from relatives)
- Presence of relatives during resuscitation attempt (report whether this practice is allowed and how it is handled)
- Care of survivors (describe any extra steps the hospital supports to provide quiet rooms, chaplains on call, social workers, grief training for personnel)

ACLS indicates advanced cardiac life support; AHA, American Heart Association; BLS, basic life support; CPC, Cerebral Performance Category; CPR, cardiopulmonary resuscitation; DNAR, do not attempt resuscitation; ERC, European Resuscitation Council; ROSC, return of spontaneous circulation; and VF, ventricular fibrillation.

*See Fig 5 for an example form incorporating these recommendations.

†A directive was entered into the medical record before the event stating that medical personnel should not attempt resuscitation.

The task force discussed a single, easily recognized criterion to define a resuscitation attempt. Published work suggests that "chest compressions started" would provide an unambiguous criterion.[125] In addition, chest compressions started is consistent with the out-of-hospital Utstein nomenclature for the denominator starting point.[24,30] The disadvantage of the chest compression started criterion, however, is that it excludes many patients who do not require chest compressions because personnel resuscitate them by defibrillation or airway interventions only. For example, patients with monitored pulseless VT or VF may be treated successfully by immediate defibrillation. This action would obviate the need for chest compressions.

Respiratory compromise and deterioration, especially in children, could lead to bradycardia, hypotension, asystole, and full cardiac arrest.[126] Timely airway interventions, however, can prevent this sequence. To measure the full range of resuscitation success for in-hospital resuscitation, the Utstein task force defines a resuscitation attempt as any effort to restore effective ventilation, oxygenation, and circulation to a patient by the use of any or all of the following methods: defibrillation, cardiac pacing, chest compressions, airway interventions, or intravenous medications. These efforts should be included as subsets in template box 3.

Which patients should be moved farther down the main trunk of the template? Some investigators suggest that the majority of patients who should be moved below box 3 will require combination interventions and are in complete cardiac arrest. The definition of complete in-hospital cardiac arrest is based on the definition recommended for out-of-hospital arrest: absence of a palpable pulse and initiation of chest compressions.[24,30] All signs of cardiac arrest, however, such as unresponsiveness and apnea, may not be relevant in all hospital patients. Sedation or anesthesia-induced apnea during artificial ventilation may eliminate the criterion of unresponsiveness. Therefore, the following definition of complete cardiac arrest is recommended:

- Absence of a palpable pulse
- Unresponsiveness due to any cause
- Apnea, agonal respiratory attempts, or artificial ventilation

Template Box 4: False Arrests:

- BLS or ALS actions not needed

Box 4 provides a place to record false arrests or activations of a resuscitation response for an event that does not represent a true cardiopulmonary emergency. Many events, such as vasovagal episodes, faints, seizures, calls for security help, or a variety of other calls, may precipitate an in-hospital emergency response. Personnel often complete an emergency response form or in-hospital audit form for these events. Several researchers, however, have argued for the need to avoid using near-arrests, false arrests, or response team activations to calculate outcome rates.[125,127,128] Although these events document the activity of a hospital's emergency response team, such events should not be used to compare outcomes between hospitals.

Template Box 5: Non-VF/VT:

- Asystole
- PEA

Asystole is defined as complete electrical silence, that is, no cardiac electrical activity can be detected with body-sur-

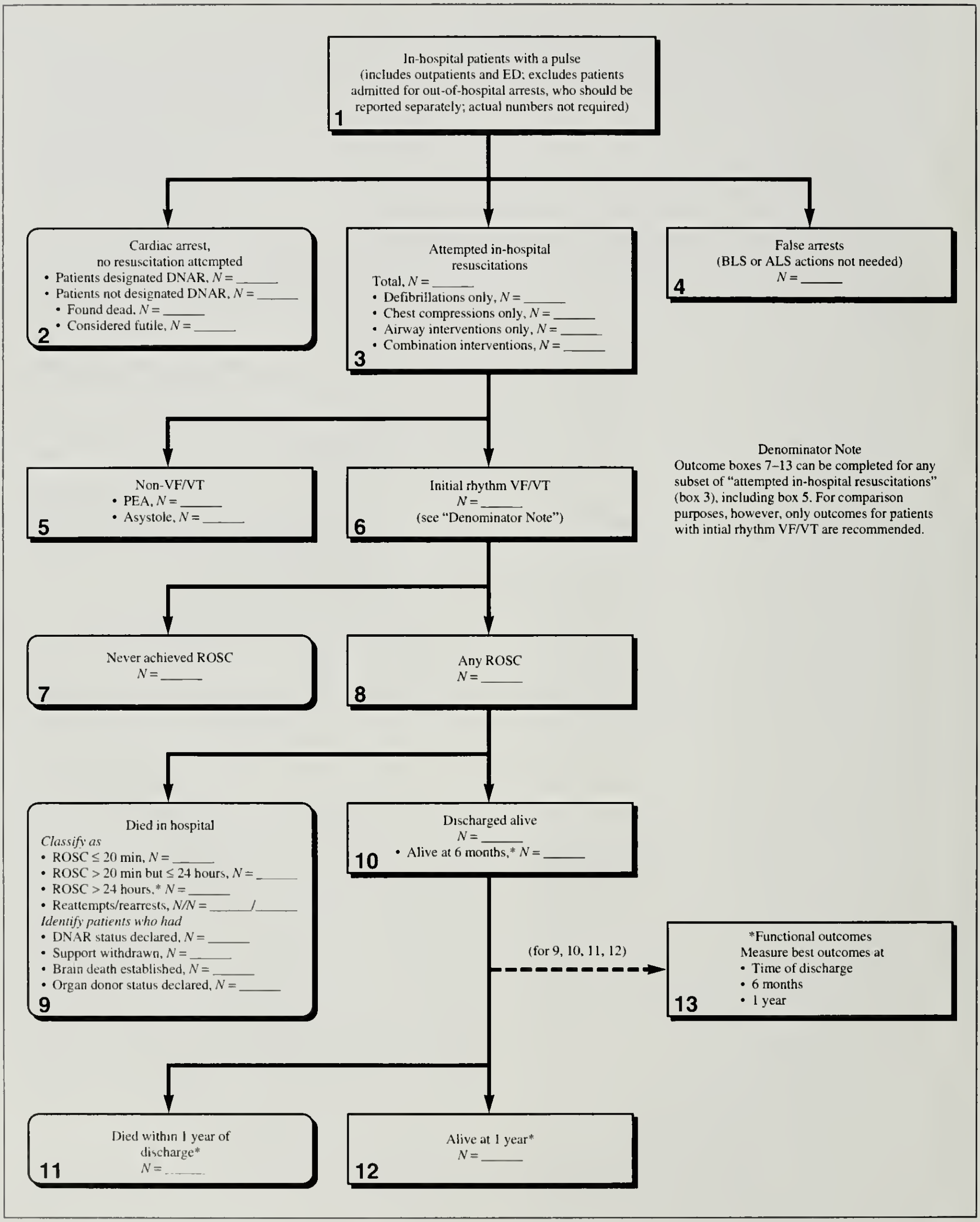
In-hospital patients with a pulse (includes outpatients and ED; excludes patients admitted for out-of-hospital arrests, who should be reported separately; actual numbers not required)
1
Cardiac arrest, no resuscitation attempted
• Patients designated DNAR, N = ______
• Patients not designated DNAR, N = ______
• Found dead, N = ______
• Considered futile, N = ______
2
Attempted in-hospital resuscitations
Total, N = ______
• Defibrillations only, N = ______
• Chest compressions only, N = ______
• Airway interventions only, N = ______
• Combination interventions, N = ______
3
False arrests (BLS or ALS actions not needed)
N = ______
4
Non-VF/VT
• PEA, N = ______
• Asystole, N = ______
5
Initial rhythm VF/VT
N = ______
(see "Denominator Note")
6
Denominator Note
Outcome boxes 7–13 can be completed for any subset of "attempted in-hospital resuscitations" (box 3), including box 5. For comparison purposes, however, only outcomes for patients with intial rhythm VF/VT are recommended.
Never achieved ROSC
N = ______
7
Any ROSC
N = ______
8
Died in hospital
Classify as
• ROSC ≤ 20 min, N = ______
• ROSC > 20 min but ≤ 24 hours, N = ______
• ROSC > 24 hours,* N = ______
• Reattempts/rearrests, N/N = ______/______
Identify patients who had
• DNAR status declared, N = ______
• Support withdrawn, N = ______
• Brain death established, N = ______
• Organ donor status declared, N = ______
9
Discharged alive
N = ______
• Alive at 6 months,* N = ______
10
(for 9, 10, 11, 12)
*Functional outcomes
Measure best outcomes at
• Time of discharge
• 6 months
• 1 year
13
Died within 1 year of discharge*
N = ______
11
Alive at 1 year*
N = ______
12

Fig. 2. In-hospital Utstein-style template. ALS indicates advanced life support; BLS, basic life support; DNAR, do not attempt resuscitation; ED, emergency department; PEA, pulseless electrical activity; ROSC, return of spontaneous circulation; and VF/VT, ventricular fibrillation/ventricular tachycardia.

face electrodes. Electrical activity that is < 1 mm in amplitude (at a calibration of 10 mm/mV) should be classified as asystole. The rate division between asystole and PEA (see below) is not well defined. A pulseless rate < 10 beats per minute (bpm) was selected as the definition of asystole, but this is an arbitrary figure. So-called "P-wave asystole" was discussed as a possible subset of asystole that should be identified and treated specifically, for example, with cardiac pacing. The task force, however, could reach no consensus on this entity and whether it should be treated differently from asystole without P waves.[129] In-hospital patients with asystole may have a prognosis different from that of out-of-hospital patients with asystole[130] because in-hospital asystolic patients have a shorter duration of asystole.

PEA is any other non-VF/VT pulseless rhythm apart from asystole. A variety of subcategories of PEA are possible. Narrow complex PEA is thought to have a better prognosis than wide-complex PEA, especially if the PEA rate is rapid (suggesting, eg, hypovolemia). PEA with a slow rate may respond to cardiac pacing. The value of subdividing patients into such categories is unclear, and no specific recommendations were developed.[131]

Template Box 6: Initial Rhythm VF/VT: VF is defined as disorganized, irregular electrical activity that produces no appreciable cardiac pumping action. The dividing point between asystole that should not be shocked and "fine VF" that should be shocked remains controversial. Utstein I defined VF as starting when the peak-to-trough deflections on the surface electrocardiogram are >1 mm in amplitude (at a calibration of 10 mm/mV) and faster than 150 bpm.[24]

Studies have shown that a lower percentage of victims of in-hospital cardiac arrest are in VF compared with out-of-hospital patients. Nevertheless, VF is the "rhythm of survival" for most cardiac arrest patients, both in hospital as well as out of hospital. Rapid identification of patients who are in VF must remain a major objective of all resuscitation attempts.

With box 6 the template has arrived at the index point for all subsequent outcome results. Boxes 1 through 4 present important data for setting the context of outcome results. Although a variety of outcome rates can be calculated using the numbers in boxes 1 through 4 as denominators, the task force recommends that box 6 serve as the parent denominator for uniform reporting of adult in-hospital arrests. As discussed below, there are several recommended survival rates for interhospital comparisons. Process gold standards (eg, intervention intervals), however, may prove to be more useful in light of the complicating elements of frequent comorbid conditions and varying levels of severity.

Template Box 7: Never Achieved ROSC: Box 7 displays the true failures of in-hospital resuscitation, that is, patients who do not respond to resuscitation efforts with even a brief ROSC.

Template Box 8: Any ROSC: In the out-of-hospital Utstein style, any return of a spontaneous pulse, detectable by palpation of a central artery (carotid or femoral), is considered ROSC; no minimal duration for spontaneous circulation is required.[24] This recommendation intends to capture any possible promising therapy or intervention, even though a few minimally palpable pulses cannot be considered return of "spontaneous circulation." Intermittent ROSC refers to patients who have brief periods of ROSC but who require CPR between these episodes. Sustained ROSC is defined as the single, continuous presence of palpable pulses for more than 20 minutes. ROSC lasting longer than 20 minutes may also be used to define when one CPR attempt ends and a new episode begins.

Arrest may occur in a patient who already has invasive hemodynamic monitoring devices in place. Cardiac output may be detected by techniques such as intravascular pressure monitoring, transesophageal or thoracic echocardiography, or Doppler pulse detection. In these patients, detectable cardiac output should be recorded, even when a pulse is not palpable. Detectable cardiac output without a palpable pulse ("pseudoelectromechanical dissociation") may be associated with improved outcome.[132]

Template Box 9: Died in Hospital:

- ROSC ≤ 20 minutes
- ROSC > 20 minutes but ≤ 24 hours
- ROSC > 24 hours

Box 9 is for recording patients who are successfully resuscitated but who do not survive to hospital discharge. The task force recommends three categories of ROSC, each one indicating a longer duration of sustained, spontaneous circulation: < 20 minutes, > 20 minutes but ≤ 24 hours, and > 24 hours. The < 20-minutes category is for patients who are briefly resuscitated; they may experience only a few seconds of detectable cardiac output. Resuscitation in such patients cannot be called successful. Patients who live at least 24 hours (ROSC > 24 hours) are considered successfully resuscitated (see below) even if they do not survive to discharge. Patients with ROSC > 20 minutes but ≤ 24 hours are an intermediate category. Box 9 was included in the template to attach greater meaning to sustained ROSC. Early death in the first day most often occurs as a result of continuing cardiovascular compromise in patients who never regain consciousness after CPR.[117]

- Reattempts/rearrests

Template box 9 also presents a means for handling the complicated problem of analyzing patients with multiple arrests during the same hospitalization. If every attempted resuscitation is reported as a separate event, rates of successful resuscitation will be inflated, and rates of survival to hospital discharge will be reduced. This poses the methodological questions of whether the denominator for outcome measurements should be reported per patient or per attempted resuscitation and whether the numerator should be successful resuscitation (ROSC > 24 hours) or successful discharge. The following example illustrates this problem.

Two patients experience in-hospital cardiac arrest. The first patient arrests, is successfully resuscitated, and is discharged alive. The second patient has a stormy course, arresting 9 times during a prolonged hospitalization. Personnel cannot resuscitate this patient during the ninth arrest, and the patient dies. The following outcome rates can be calculated:

Numerator/denominator	Outcome rate
Patients discharged alive/patients with one or more arrests	1 of 2 (50%)
Patients discharged alive/resuscitation attempts	1 of 10 (10%)
Successful resuscitations/resuscitation attempts	9 of 10 (90%)

The task force recommends that all three outcome rates be available. Because some hospitals will have only a small number of patients in these categories, calculation of all possible rates or percentages may fail to adequately express the clinical variability that exists. Confidence intervals improve interpretation of the study data by indicating the degree of uncertainty about an observation. Recent resuscitation research provides a useful illustration of the use of confidence intervals to express outcome data.[133]

Identify the number of patients in whom

- DNAR status was declared
- Support was withdrawn
- Brain death was established
- Organ donor status was declared

Physicians may treat patients several different ways after a successful resuscitation. Some patients may be given maximum therapy in a concerted effort to help the patient survive to hospital discharge. Alternatively, physicians may, in consultation with family members, reevaluate survivors after the first in-hospital arrest and place these patients in other management categories, which include declaring the patient brain dead or DNAR, withdrawing ventilatory and pharmacological support, and considering whether the resuscitated patient would be a suitable organ donor. Subsequent cardiac arrests in these patients may be "unresisted," as suggested by Longstreth and Dikmen.[67] The management of these survivors of an initial cardiac arrest can profoundly change in-hospital survival rates.

Identification of patients for whom support is limited or withdrawn will help answer an important question: Are some differences in survival between centers related to different approaches to the care of patients with severe compromise after resuscitation? From an epidemiological perspective, these patients are eliminated from the survivor numerator. Their failure to survive would adversely reflect on the resuscitation success of the hospital. Because these patients are removed from any possibility of surviving the index cardiac arrest, they should be identified and specifically reported in template box 9.

Template Box 10: Discharged Alive:
Total

- Alive at 6 months
- Alive at 1 year

The most frequently used outcome measure for cardiac resuscitation is the rate of survival to hospital discharge. The numerator for this rate is the number of patients discharged from the hospital with spontaneous circulation and ventilation. The task force recommends notation of the number discharged alive, the number alive at 6 months, and the number alive at 1 year.

Unique discharges, such as patients with brain death transferred to another hospital for organ donation, should be reported separately. Such patients do not represent a successful resuscitation. A variety of discharge destinations are possible, ranging from preadmission residence to intensive care custodial facilities. Patients transferred to another hospital for further diagnostic or therapeutic procedures are listed as discharged alive for the hospital where the cardiac arrest occurred. Accounting for these patients, if they die in the recipient hospital, will occur when length-of-survival and functional outcomes are determined (template boxes 11 and 12).

Patients may occasionally be discharged with a spontaneous pulse and respirations yet require intravenous medications such as vasopressors, antiarrhythmics, and cardiac inotropes, or intermittent advanced ventilatory support. Whether such patients merit reporting as successful survivors of in-hospital cardiac arrest is debatable. Common sense is needed. Exceptional patients may fall so far outside the usual definitions that they will need to be reported separately.

Template Box 11: Died Within 1 Year of Discharge

Template Box 12: Alive at 1 Year: Once a patient is discharged alive from the hospital, outcome auditing requires date of death (if death occurs during the first year after discharge) or confirmation that the patient is alive after 1 year. These data do not flow routinely into the hospital where the index arrest occurred. Researchers must therefore establish an additional data collection system, such as telephone calls and surveillance letters; postcards and questionnaires to care facilities, patients, relatives, and physicians; death certificate review; and periodic home visits. The key, according to researchers who have published the best data on length of survival, is a single, dedicated research associate who establishes a close relationship with the survivors and their families and contacts them at regular intervals.[105,134] In the United Kingdom, the Office of Population and Census prospectively tracks people who meet specified criteria (eg, survivor of cardiac arrest) and notifies researchers of the date and certified cause of death when death occurs.

Problems arise when patients are transferred (from hospital to nursing facility to home and back again); when patients or their families change hospitals and physicians; when patients relocate (to other addresses, cities, even states and countries); when telephone calls or surveillance letters are not returned; and when there is a lack of cooperation among the physician, patient, and family.[130,135]

The date of death for arrest survivors who die after discharge should be available through death certificates. Gaining access to and tracking death certificate data may be a problem in some regions, states, and countries. In the United States, social security numbers are the indexing codes used in most death-certification programs. This number, however, is often not recorded in hospital records or is not available to researchers because of patient confidentiality concerns.

The survival data can be presented in several valid ways. A simple percentage (number alive at 1 year over number discharged alive from the hospital) is the most straightforward calculation. However, survivors to hospital discharge are not released at one point in time; a hospital's successful discharges are staggered over many weeks and months. Therefore, by definition, all survival-to-1-year data will be 1 year out of date because allowance must be made for the last individual discharged alive to have a chance to live 1 year.

Most survival studies solve this problem by using some method of calculating probability of survival to 1 year. These probabilities then must be adjusted for attrition, death, relocation and transfer, inability to follow up, loss to follow-up after enrollment, lack of information, or lack of cooperation. Newly discharged-alive patients enter the study survivors group upon discharge. They remain in that group until "removed" from the cohort by one of the events noted above (death, loss to follow-up, etc). Kaplan-Meier survival curves are the most widely used statistical means for presenting these data. (For more detailed information, refer to Kaplan and Meier.[136])

Another recommended statistical approach to expressing survival is a modification of the life-table method adopted by the United Kingdom Resuscitation Council in BRESUS.[22] In that study survival was viewed from two perspectives. First, beginning at the time of the arrest, investigators determined how many people would live through subsequent time periods. Survival results can be reported from either single or overlapping periods. For example, the BRESUS investigators observed the following survival rates: 71.7% from the arrest to 24 hours, 62.7% from 24 hours to discharge, 71.8% from discharge to 1 year, 32.4% from 24 hours to 1 year, and 12.5% from arrest to 1 year.[22] In the second approach, the BRESUS investigators asked how many attempted resuscitations are required to produce 1 survivor at 1 year. The results demonstrated that for every 1-year survivor there were 8 attempted resuscitations, 3 initial survivors, 2 who survived the first 24 hours, and 1.5 who left the hospital alive.[22]

The Utstein Task Force recognizes the need to establish a body of published survival rates of in-hospital cardiac arrest that use comparable definitions of survival. Because the BRESUS report is the largest existing report of in-hospital survival rates, it is advantageous for other projects to use the BRESUS definitions. The Utstein Task Force therefore recommends that researchers use the data from template boxes 9 through 12, combined with the life-table method to allow for losses to follow-up,[22] to calculate the following survival rates:

- Percent survival from the arrest to at least 24 hours (ROSC > 24 hours)
- Percent survival from successful resuscitation (ROSC > 24 hours) to 1 year
- Percent survival from arrest to discharge
- Percent survival from discharge to 1 year
- Percent survival from arrest to 1 year

For each survivor alive at 1 year, calculate the following:

- Number of attempted resuscitations
- Number of initial survivors
- Number surviving first 24 hours
- Number leaving the hospital alive

Template Box 13: Functional Outcomes: The functional outcome (neurological and psychological status) should be measured at the following times:

- Hospital discharge
- 6 months to 1 year

The dashed line to box 13 indicates that assessment of outcome is completed only by providing a measure of functional outcome. Ideally, researchers should record the best neurological and psychological status achieved after resuscitation. Research, however, has not established the best measures of quality-of-life or functional outcomes after cardiac arrest.[105,106,116,130,131] The optimal time intervals for performing functional assessments are unknown.[118] The task force recommends, as a minimum, assessment of functional outcome near the time of hospital discharge and again at 6 months to 1 year. Practical concerns support general use of the CPC score, whereas for more focused research projects additional measures are needed.[116] Some research suggests that patients reach their maximum level of recovery from the original anoxic or ischemic event of the cardiac arrest between 6 and 12 months.[118] After that point, patients begin to experience mortality and morbidity because of age and preexisting illnesses.[106]

Data to Collect on Individual Patients

Table 1 lists the data on individual patients that the task force recommends be collected. These data will support analyses for intrahospital audits and interhospital comparisons and will allow completion of the in-hospital Utstein-style template (Fig 2). This approach was pioneered in the first Utstein-style guidelines for reporting out-of-hospital cardiac arrest.[24,30] However, the task force acknowledges a conceptual debt to the uniform data sets designed by Spaite et al[137] for the National Highway Traffic Safety Council.

Unfortunately, no single cardiac arrest audit form can capture all the recommended data. The primary problem emanates from the methodological challenge of data synchronization. This problem is illustrated in Fig 3, which demonstrates that researchers can gather complete resuscitation data about an individual only by moving back and forth in time.

An individual patient first becomes of interest for data collection when he or she suffers an in-hospital cardiopulmonary emergency. At the time of the resuscitation attempt, personnel record only immediate hospital and patient data about the resuscitation (eg, time of defibrillation). Immediately after resuscitation, patient variables can be gathered by reviewing the patient's hospital records. Outcome data (eg, date of death) can be collected by a prospective surveillance system, but this requires linking the clinical information with the surveillance system. Prospective surveillance may incorporate use of telephone calls, physician office records, and death certificates. Most functional outcome measures will require patient examinations or face-to-face interviews. The problem of multiple records stored and analyzed over time has been reduced significantly by the widespread availability of personal computers and easy-to-use data management software. Nevertheless, considerable advance thought and planning is needed to conduct comprehensive analyses of in-hospital resuscitations.

Gold Standard for Outcome Comparisons

Comparing Resuscitation Success Among Hospitals

The task force carefully thought about whether one of the survival rates included in template boxes 10 (discharged alive), 11 (died within 1 year of discharge), or 12 (alive at 1 year) should be defined as the gold standard for interhospital and intrahospital comparisons. The most attractive rate appears to be the percentage of survival from arrest to hospital discharge. This rate is analogous to the gold standard recommended for out-of-hospital cardiac arrest: survival rate to hospital discharge of patients who had nontraumatic, witnessed VF.[24,30]

After consideration of the enormous heterogeneity in hospitalized patients who experience cardiac arrest, the task force recognized that a single measure for interhospital comparison would be invalid and unrealistic. The average number of cardiac arrests in BRESUS, which included 12 hospitals, was 240 per hospital per year, or 20 per month. This total must be divided among different etiologies, severities of illness, arrest locations, and other comorbid conditions. The crude survival rates from hospital to hospital vary significantly by the nature of the hospital (community versus tertiary-care referral hospital), by the presence of an emergency department and/or specialized cardiac and other units, and by the demographics of the patient population. The task force recognizes that no individual hospital will have enough patients to support meaningful interhospital outcome comparisons. Therefore, no single gold standard recommendation for outcome comparisons is made. Nevertheless, researchers should provide the survival rates listed above in template boxes 10, 11, and 12.

Process Gold Standard

Although the task force recognizes that interhospital comparisons based on outcome would be invalid, it does recommend comparisons based on process. The task force concluded that a simple and robust gold standard is the time interval from collapse to first shock for patients with documented VF. This interval should be documented for all patient areas. In addition, the hospital must document the time intervals from recognition of the emergency to application of other ALS interventions, including endotracheal intubation and administration of intravenous medications. Therefore, three interhospital comparators are recommended:

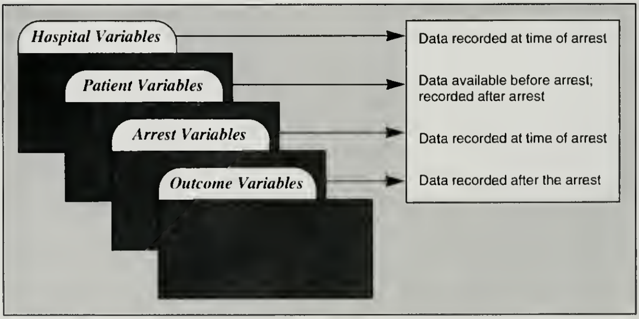
Hospital Variables
Patient Variables
Arrest Variables
Outcome Variables
Data recorded at time of arrest
Data available before arrest; recorded after arrest
Data recorded at time of arrest
Data recorded after the arrest

Fig. 3. The problem of data syncopation: different variables become available at different times.

- Interval from collapse to first shock for patients in VF or pulseless VT
- Interval from collapse to achievement of advanced airway management
- Interval from collapse to first intravenous administration of epinephrine

In-Hospital 'Chain of Survival'

To evaluate a hospital according to the three comparators, the separate contributions of early recognition, call for help, and arrival of the cardiac arrest team should be analyzed. The task force recommends comparing the interval from collapse to call for help and the interval from call for help to delivery of definitive interventions (defibrillation, achievement of advanced airway management, and administration of epinephrine).

These proposed comparators make up the major links in an in-hospital chain of survival, a conceptual metaphor that allows in-depth analysis of outcomes for out-of-hospital emergency cardiac care.[138-140] Researchers in the United States, such as Kaye et al,[141-143] have used this concept to model in-hospital cardiac resuscitations and provide an approach to improving outcomes. For most hospitals this requires strengthening the early defibrillation link in the chain of survival by allowing nonphysician in-hospital responders to perform defibrillation. This concept has received widespread international endorsement by the world's major resuscitation councils.[144,145] The widespread availability of automated external defibrillators, with their documented ease of training,[146] provides the technological capacity to support such early defibrillation programs.

Fig 4 demonstrates interventions needed for successful in-hospital resuscitation. The shorter the time interval between these interventions, the higher the probability of survival:

- Emergency is recognized, response team is activated (early access)
- Personnel start CPR (early CPR)
- Personnel assess rhythm and deliver defibrillatory shocks for patients in VF/VT (early defibrillation)
- Personnel arrive and perform endotracheal intubation, establish an intravenous lifeline, deliver resuscitative medications, and consider the differential diagnosis (early ALS)

Resuscitation Quality Assessment: Standard Reporting of In-Hospital CPR

To assist hospitals in adopting these in-hospital uniform guidelines, most of the essential variables listed in Table 1 have been incorporated into a form titled "Standard Reporting of In-Hospital Cardiopulmonary Resuscitation" (Fig 5). Collection of these data will support both patient care and patient quality assessment. This form duplicates the format of cardiac arrest forms already used in many hospitals.

The Utstein Task Force recognized that traditional quality assessment for in-hospital resuscitation served a valuable purpose, but hospitals need to adopt more robust methods to assess the quality of resuscitation, that is, outcome and time trends. In the United States most hospital quality-assessment activities are driven by the requirements of the Joint Commission on Accreditation of Health Care Organizations.[147] Most accredited US hospitals establish a cardiac arrest committee that sets policies for resuscitation responses and reviews the management of all in-hospital cardiac arrest patients. In the majority of US hospitals these code committees evaluate structure (are resuscitation trolleys stocked and equipped? are defibrillators available in all patient care areas? did the equipment function properly?) and some process (were BLS and ALS performed in accordance with accepted standards

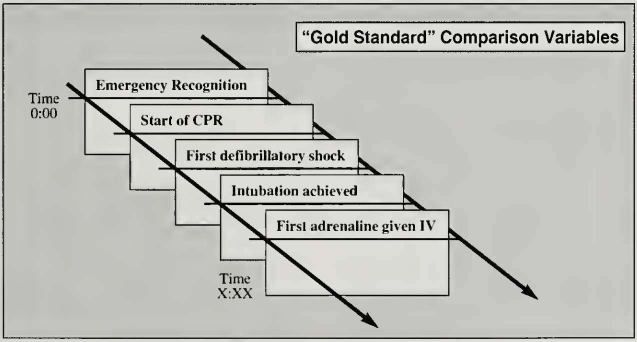
"Gold Standard" Comparison Variables
Time 0:00
Emergency Recognition
Start of CPR
First defibrillatory shock
Intubation achieved
First adrenaline given IV
Time X:XX

Fig. 4. Recommended gold standard arrest events and time intervals. These events and time intervals should be recorded for all arrests and used for intra- and interhospital comparisons. IV indicates intraveneously.

and guidelines?). These important evaluations should continue to be made.

The process variables recommended (Figs 4 and 5) by the Utstein Task Force should be associated with superior outcomes, assuming that the lessons in epidemiology and pathophysiology learned out of the hospital apply equally well to the in-hospital setting. Hospital cardiac arrest committees must review the response system continuously and require that these intervention intervals are acceptable. Use of the in-hospital Utstein-style reporting form (Fig 5) will assist in these activities, as will using the in-hospital Utstein-style template (Fig 2). The principles of continuous quality improvement dictate that hospitals address any identified problems and make any necessary adjustments to educational and training programs, equipment, and the system. The AHA ACLS course and similar courses provided by the Resuscitation Council (United Kingdom) and the Scandinavian Resuscitation Council provide a uniform treatment approach to optimize outcomes. Hospitals should strongly encourage all personnel who may be called on to participate in a resuscitation attempt to take these courses and to retake them with appropriate frequency.

In addition, the In-Hospital Utstein Task Force recommends that hospital cardiac arrest committees expand their mandate beyond structure and process concerns for individual patients. Data for the Utstein-style template (Fig 2) and the recommended uniform data (Table 1 and Fig 5) support intrahospital outcome assessment and interhospital comparisons. A database containing the information recommended in these guidelines will permit pooling of data for many patients and assessment of trends over time. Outcome information such as resuscitation and discharge rates, functional levels of survivors, and length of survival are all important parameters to assess.

The circumstances, interventions, and responses of a resuscitation attempt constitute a critical part of a patient's medical record. Although these data should be recorded as completely and accurately as possible, the confusion and urgency of most resuscitation efforts prohibit accurate event documentation. The task force selected uniform in-hospital resuscitation data (see Table 1) and designed the standard reporting form (Fig 5) to contribute to research, clinical epidemiology, and proper patient care.

In addition, the uniform set of data and standard reporting form will help hospitals reduce the risk of medical litigation. In the United States, unsuccessful resuscitations or resuscitation attempts that leave the survivors neurologically impaired all too often stimulate medical-legal record reviews. Distressed family members contact attorneys, who then commission medical experts to review the records. The focus of these reviews becomes "did the emergency providers render proper and timely care?" and "were there any violations of the standard of care that a reasonably prudent physician would provide?" From the perspective of risk management and avoidance of medical litigation for wrongful death, it is critical that emergency care providers document the events of the resuscitation attempt as accurately and precisely as possible, particularly time from collapse to first defibrillation. Routine completion of the standard reporting form will supply most of the specific details of care needed for medical-legal reviews.

A number of important technological advances promise to make event documentation even more accurate, convenient, and useful. At the center of these technological advances is the defibrillator/monitor. Research has repeatedly shown that defibrillation is the most important intervention in adult resuscitation. Because of the need for early rhythm assessment and defibrillation—every resuscitation attempt requires a defibrillator and monitor—defibrillators have become sophisticated electronic devices for event documentation. Many new technological advances appear first as add-ons to defibrillators (eg, synchronized cardioversion, transcutaneous pacing, pulse oximetry, capnometry, and automatic blood pressure monitoring).

Critical extra features for defibrillators are automated rhythm analysis capability and shock advisory defibrillation. Both automated and conventional external defibrillators now include several microprocessor-based techniques for event documentation. These techniques include two-channel magnetic tape recorders, Personal Computer Memory Card International Association (PCMCIA) cards, digitized audiotapes, and bar-code readers. The recorded data, which include cardiac rhythm, audio recordings, therapeutic interventions (eg, administration of medications and intubation), and other patient parameters, can be downloaded to master databases through direct lines, telephone lines, or personal computer card readers. The anticipated widespread greater use of automated external defibrillators during in-hospital arrests should make these approaches readily available.[148-150]

Several manufacturers have developed database management software to store and analyze patient care data (eg, Utstein Reporter™ data management software [Laerdal Medical Company, Stavanger, Norway] and the CODE-STAT™ data management system [Physio-Control Corporation, Redmond, WA, USA]). These software data management programs comply with the recommendations of the out-of-hospital Utstein-style guidelines and will be upgraded to reflect the recommendations of the in-hospital guidelines.

Fig. 5. (pages 53-54) Form for standard reporting of in-hospital cardiopulmonary resuscitation. AHA indicates American Heart Association; ALS, advanced life support; CAD, coronary artery disease; CCU, coronary care unit; CPR, cardiopulmonary resuscitation; defib, defibrillation; DNAR, do not attempt resuscitation; ECG, electrocardiographic; ED, emergency department; EPI, epinephrine; ERC, European Resuscitation Council; ET, endotracheal tube; ICD-CM, International Classification of Diseases, ninth edition; ICU, intensive care unit; IV, intraveneous; MI, myocardial infarction; PAR, Prognosis After Resuscitation Score, PEA, pulseless electrical activity; ROSC, return of spontaneous circulation; VF, ventricular fibrillation; VT, ventricular tachycardia.

STANDARD REPORTING OF IN-HOSPITAL CARDIOPULMONARY RESUSCITATION

1 Date of event ☐☐ ☐☐ ☐☐
MONTH DAY YEAR

2 Location
- ☐ CCU
- ☐ ICU
- ☐ ED
- ☐ Outpatient
- ☐ Diganostic & intervention
- ☐ Other ____________________
- ☐ PAR
- ☐ Operating area
- ☐ General care

3 Witnessed? ☐ Yes ☐ No ☐ Unknown
Monitored? ☐ Yes ☐ No

4 ACLS interventions at time of event *(check all that apply)*
- ☐ None
- ☐ IV access
- ☐ IV medications
- ☐ ECG monitor
- ☐ Intubation
- ☐ Mechanical ventilation
- ☐ Implantable defibrillator/ cardioverter
- ☐ Intra-arterial catheter

Name ☐
Date of birth ☐☐ ☐☐ ☐☐
MONTH DAY YEAR
Age ☐☐☐
M ☐ F ☐ Unknown ☐
Admit date ☐☐ ☐☐ ☐☐
ID# ☐☐☐☐☐☐☐☐☐☐

EVENT VARIABLES

5 Immediate cause
(check one)
- ☐ Lethal arrhythmias
- ☐ Hypotension
- ☐ Respiratory depression
- ☐ Metabolic
- ☐ MI or Ischemia
- ☐ Unknown
- ☐ Other ____________________

6 Resuscitation attempted?
- ☐ Yes *(check all used)*
  - ☐ Chest compressions
  - ☐ Defibrillation
  - ☐ Airway
- ☐ No *(check one)*
  - ☐ Found dead
  - ☐ Considered futile
  - ☐ DNAR

7 Initial condition
Conscious? ☐ Yes ☐ No
Breathing? ☐ Yes ☐ No
Pulse? ☐ Yes ☐ No

9 Event times
(shaded times are required to calculate the AHA and ERC in-hospital chain-of-survival intervals)

Collapse/Onset ______:______
CPR team called ______:______
CPR team arrived ______:______
Arrest confirmed ______:______
CPR started ______:______ = ______ min
1st defib shock ______:______ = ______ min
Airway achieved ______:______ = ______ min
1st dose EPI ______:______ = ______ min

8 Initial rhythm
- ☐ VF
- ☐ VT
- ☐ PEA
- ☐ Bradycardia
- ☐ Asystole
- ☐ Perfusing rhythm

CPR stopped ______:______

Why?
☐ ROSC ☐ Futile
☐ Death ☐ DNAR

Spontaneous circulation
- ☐ Returned *(if yes, time of ROSC)* ______:______
- ☐ Never achieved
- ☐ Unsustained ROSC:
  - ☐ ≤ 20 min
  - ☐ > 20 min but ≤ 24 hours
  - ☐ > 24 hours

OUTCOME VARIABLES

10 Time of awakening Time ______:______ **Date** ☐☐ ☐☐ ☐☐

11 In-hospital event outcome *(check one)*
☐ Hospital discharge **Date** ☐☐ ☐☐ ☐☐
Discharge destination: other hospital ______ home ______
chronic care facility ______ other ______
*CPC at discharge = ______
*Total GCS = ______ [eye ______ verbal ______ motor ______]

☐ In-hospital death *(ROSC > 24 hours)* **Date** ☐☐ ☐☐ ☐☐

12 Alive at six months?
☐ Yes (*CPC) = ______ ☐ No (Date of Death) ______/______/______ ☐ Unknown

12 Alive at one year?
☐ Yes (*CPC) = ______ ☐ No (Date of Death) ______/______/______ ☐ Unknown

14 If died, principal cause of death
☐ CAD ☐ Trauma
☐ Cancer ☐ Other medical

15 ICD-CM code
☐☐☐☐☐☐

16 Information source *(for 14 & 15)*
- ☐ Medical records
- ☐ Death certificate
- ☐ Personal physician
- ☐ Autopsy
- ☐ Other

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*CPC (Cerebral Performance Category) 1 = good, 2 = moderate, 3 = severe, 4 = comatose, 5 = brain death
*GCS (Glasgow Coma Score) eye 1–4, verbal 1–5, motor 1–6.

ADDITIONAL INFORMATION

Name ______

Admit date ☐☐ ☐☐ ☐☐
MONTH DAY YEAR

ID# ☐☐☐☐☐☐☐☐☐☐

17 Provider of CPR

☐ Nurse
☐ Physician
☐ Respiratory therapist
☐ Clinical assistant
☐ Other

18 ET Intubation Time ______:______

19 Treatments during event *(below)*

Time	Comments	Vitals	Rhythm	Defib (J)	Medications	Dose/route

Please check that all information is complete and accurate.

Resuscitation Quality During Resuscitations

In many institutions a member of the cardiac arrest team fills out an evaluation form that assesses the quality of the resuscitation effort. These reports identify specific problems, such as the adequacy of BLS, delays in arrival of the defibrillator or other equipment, delays in intubation, and possible absence or malfunction of resuscitation equipment. These items may be described in a comments section on the cardiac arrest audit form. Although essential for in-hospital quality assurance, these items will not be available for numerical analysis for comparisons between hospitals. They should be confidential documents for quality assurance and reviewed only by a properly authorized committee. They should not become part of the patient's medical record.

A growing body of research suggests that resuscitation interventions must be performed not only early but well. Several studies document that all four of the major components of resuscitation may be performed poorly: chest compressions and ventilation rates,[151-153] defibrillation,[154,155] endotracheal intubation, and administration of intravenous medications. In one study of in-hospital resuscitation, 83% of chest compression rates and 100% of ventilation rates were outside the recommended BLS guidelines.[152] Another project assessed the quality of out-of-hospital resuscitation and judged 48% of CPR efforts to be poor.[153] These observations are important because the quality of CPR efforts correlates with successful resuscitation.[156] Incorrect CPR was associated with a 14-day survival rate of 4% compared with a survival rate of 16% when CPR was performed correctly.[153] Another study demonstrated that correctly performed bystander CPR was independently associated with better survival to hospital discharge, while ineffective CPR was not associated with improved survival.[151]

In addition to simple observation by resuscitation team members, researchers have sought a physiological variable that can be used to provide feedback to emergency personnel during resuscitation attempts. The following variables were examined: hemodynamics, capnometry, oxygenation, and pulses.

Hemodynamics

Hemodynamic pressures during cardiac resuscitation correlate well with resuscitation success.[157-161] Rescuers attempt to optimize coronary perfusion pressure by increasing the aortic diastolic pressure with effective chest compressions and pressor agents.[157-161] Such monitoring, however, requires placement of arterial and central venous catheters during a cardiac arrest, which is impractical in most resuscitation attempts. If monitoring lines are already in place, they can provide guidance.

Capnometry

With constant ventilation and systemic metabolism, end-tidal CO_2 monitoring reflects cardiac output during CPR.[162-170] End-tidal CO_2 concentrations during CPR correlate with cardiac output, coronary perfusion pressure, and successful resuscitation.[163-170] Few patients with low end-tidal CO_2 concentrations during CPR are successfully resuscitated.[170] Capnometry appears to be a useful adjunct in assessing efficacy of the resuscitation efforts. Smaller, less expensive devices are becoming available.

Oxygenation

Pulse oximetry is not useful in the assessment of patients in cardiac arrest. Oximetry requires a peripheral pulse that is unavailable during cardiac arrest. CPR chest compressions do not create a suitable peripheral pulse. Arterial blood gases demonstrate the adequacy of oxygenation but do not reflect the adequacy of perfusion during cardiac arrest.

Pulses

The presence of palpable pulses indicates the presence of some blood flow but does not provide any quantification of arterial pressures or cardiac output. The carotid pulse is the most commonly palpated pulse during CPR.[153] Femoral pulses should not be used as an indicator of arterial blood flow during CPR because compression-induced retrograde flow in the inferior vena cava produces femoral pulses that more likely indicate venous rather than arterial blood flow.

Ethical Issues

These recommendations for reporting outcomes of in-hospital resuscitation would be inappropriate without attention to the many ethical issues involved in both clinical management and research.[171-173] Quality resuscitation research must be conducted. Scientific evaluation of resuscitative efforts can benefit future patients. This research must be conducted, however, within an ethical framework, which may vary among countries and cultures.

DNAR, No CPR, Do Not Resuscitate

In certain circumstances it is acceptable and appropriate to withhold CPR efforts.[174,175] Competent and informed patients have the right to refuse CPR.[176,177] When the patient cannot make an informed decision about CPR, the decision may be based on the patient's known wishes expressed through advance directives.

Substituted judgment, where surrogates make the decision to withhold CPR, is ethically acceptable. The accuracy of substituted judgment, however, has been questioned. Seckler et al[178] found that only 16% of elderly chronically ill patients had previously discussed resuscitation preferences with their self-chosen family proxies, and neither family members nor physicians were able to predict patients' wishes adequately.

Suhl et al[179] observed that surrogates could not guess patients' wishes better than random chance.

In the United States, where the movement toward patient autonomy is stronger than in most other countries,[180] an increasing number of organizations require hospitals to review the status of advance directives with all admitted patients. Still, according to a recent review, only 20% to 38% of in-hospital patients with AIDS, cancer, or other diseases with poor prognosis had had such discussions.[181] In in-patient medical services in the United States, the frequency of DNAR orders is approximately 3% to 4% but occasionally may run as high as 9%.[181]

Medical Futility

Withholding resuscitation attempts because of medical futility, that is, the probability of a successful outcome approaches zero, remains controversial.[182-184] Most consensus panels from major health organizations (including the AHA,[185] the European Resuscitation Council,[173] the American Medical Association,[186] and the Hastings Center[174]) have concluded that it is ethically acceptable to withhold CPR when an informed physician thinks resuscitation attempts will be futile. An unambiguous and widely accepted definition of futility is still lacking. Hidden value judgments may be made by clinicians who declare futility without consultation with the patient or surrogate.[187,188]

Some investigators make a distinction between qualitative and quantitative medical futility.[187] Quantitative futility is a very low or zero probability of achieving a return of organ function and survival beyond 2 weeks. Qualitative medical futility applies when CPR may be effective in sustaining life, but the patient's quality of life falls well below the threshold considered minimal by general professional judgment.[187] In one study investigators observed that clinicians failed to discuss quality-of-life issues with a substantial number of communicative patients for whom qualitative futility was declared.[187] As a concept, medical futility must be better defined and more widely accepted if it is to affect withholding medical interventions.

Informed Consent for Resuscitation Research

Resuscitation research presents unique ethical challenges. Most tellingly, patients cannot give informed consent for participation in research protocols. Patients' wishes concerning care are often unknown at the time resuscitation efforts are undertaken. Most reports of human resuscitation research fail to report approval by research ethics committees or to address issues of subject consent.[189] Surrogate permission, from family members when applicable, is rarely available.[190,191] In the United States, federal regulations concerning informed consent resulted in a virtual halt in resuscitation research for several years in the 1990s.[192]

In response, the 1995 Coalition Conference of Acute Resuscitation and Critical Care Researchers stated that research can and should be done in clinical circumstances where it is not feasible to obtain informed, prospective, or proxy consent for enrollment in a study protocol.[191] The coalition emphasized the critical role of informed institutional review boards in circumstances in which obtaining informed consent is impossible. The local institutional review boards must establish safeguards and reviews to protect the interests and rights of potential subjects. In addition, the coalition endorsed a new risk category called "appropriate incremental risk." Incremental risk is any potential risk specifically associated with participation in the research compared with the natural consequences of the medical condition. Although patients are indeed vulnerable to research risks, they are also at risk of being denied beneficial therapy when no effective therapy currently exists.

In late 1996 the US Food and Drug Administration published an important "final rule" regarding exception to informed consent in certain emergency research circumstances. When implemented, these regulations should allow full resumption of clinical resuscitation research even when informed consent is impossible. The circumstances under which exceptions to informed consent can be made must meet the following criteria:

1. The clinical trial addresses a life-threatening condition that the individual to be enrolled has.
2. Currently available treatments are unproved or unsatisfactory.
3. The research cannot otherwise be carried out and is essential to determine the safety and effectiveness of the new treatment.
4. It is not feasible to obtain informed consent from the patient or a legal representative.
5. The risks of the experimental procedures are reasonable compared with those associated with the patient's medical condition and current standard therapy.

Additional Ethical Issues

This consensus document highlights several major ethical issues for researchers, ethics committees, and other involved parties to consider and review. At this time many researchers, clinicians, ethicists, and caregivers are debating a number of other ethical topics, including resuscitation for organ donation,[193] practicing procedures on the newly dead,[194-202] the presence of relatives during resuscitation attempts,[203-206] and caring for the survivors.[207-212] Although the task force recognizes the critical importance of these topics, consensus on these issues was beyond the scope and mandate of this document. These issues will be discussed in detail in future Utstein symposia.

Conclusions

In-hospital resuscitation is a topic of immense complexity. Existing publications more often highlight these intricacies than provide answers. The purpose of this document is as much to list topics for consideration as to provide guidelines to follow. Many of these recommendations are speculative, offered in the absence of results from research studies that use uniform definitions and terminology. They are presented in the belief that they will serve as a catalyst to much-needed research and discussion.

Table 1 lists and defines a series of individual patient variables that hospitals should collect. With these variables, a standard reporting form (Fig 5) can be completed during and immediately after a resuscitation event. Use of this form (or a similar form that contains the same variables) provides documentation of patient care during the arrest. These arrest reporting forms should become part of the medical record for each patient. Different designs may be required for different hospitals, locations, and countries.

Fig 2 presents the in-hospital Utstein-style reporting template. This template summarizes the collective experience of individual hospitals. The template can be completed using the uniform data (Table 1) collected from individual patients. Table 2 is a checklist of information to include in reports on in-hospital resuscitation. For future publications on in-hospital resuscitation, this information will allow categorization and comparison of hospitals that may use different management approaches. Table 2 also lists the final recommendations regarding resuscitation outcomes and the gold standard process intervals to report. These variables will supply the key for future interhospital comparisons.

We recognize that many individuals, hospitals, and research groups have already identified, and in many cases solved, some of the data acquisition problems addressed in these guidelines. Many other solutions and forms may exist. These recommendations are a work in progress. We encourage comments, discussion, and suggestions for improvement of the recommendations as they are used. We are particularly interested in solutions to problems of data collection, storage, analysis, and presentation.

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RETROSPECTROSCOPE REDUX:

Feet on the Ground??

How a nation decides how much and what kind of biomedical research it wants to support is of great importance to the health of its people, because even the best physician cannot "deliver" new knowledge about prevention, early diagnosis, or cure until research has uncovered it. At present, "how much" research is mostly left up to Congress and "what kind" is left to specific granting agencies and their review panels, study sections, and advisory councils, who either approve or disapprove projects initiated by scientists, or sometimes propose programs of their own.

To the present array of reviewing bodies, Congress now proposes to add another: Congress. "The House of Representatives on April 9 voted that Congress should have a veto power over all of the 14,000 grants which NSF awards each year. To accomplish this, NSF would have to submit a list of all proposed research grant awards to Congress every 30 days, as well as justifications for them. Either house could veto the award of any grant ... The provision would put Congress in the position of effectively approving research grants in every area of NSF support, from education to basic science" (1).

Why? It appears that one of the "fun games" for some Congressmen is scanning titles of approved research grants in the social and biomedical sciences and then holding up to public ridicule those that sound (to them) odd, esoteric, irrelevant, ludicrous, farcical, or absurd. The problem is that these Congressmen have not looked into the Retrospectroscope; perhaps they should, lest their public statements on what constitutes nonsensical research today form the basis for new "fun games" 10 to 20 years from now.

Let's look at a few research projects that would cause some Congressmen to roll in the aisles with laughter. A sure-fire one would have been a proposal in December 1895 if an American scientist had applied for government money to invent a machine to look at the insides of people. By 1895, science fiction writers had "invented" airplanes, submarines, and electric ray guns, and had even "created" a man reassembled from assorted bits and pieces of cadavers—but none had been brash enough to conceive of a ray that would photograph bones and heart and lungs right through the skin. Yet late in December 1895, Wilhelm Roentgen in Würzberg accomplished just that. I suspect Congress would have been embarrassed when, having vetoed this absurd (hypothetical) proposal just before adjourning for the Christmas vacation in 1895, they picked up a newspaper on New Year's Day and read on the front page of a scientific discovery by a German physicist that swept the world and revolutionized the practice of medicine.

The "look-inside-people" proposal would have caused good-natured belly laughs. But if Eadweard Muybridge had applied for a grant in 1872, his proposal would have caused indignation and outrage at the waste of the public's money on a frivolous project, by someone who wasn't even a scientist and had no scientific degree and no laboratory. Here, in Muybridge's words, is what he wanted to do; these might have served as an introduction and justification for his project:

> In the spring of 1872 ... there was revived in the city of San Francisco a controversy in regard to animal locomotion ... the principal subject of dispute was the possibility of a horse, while trotting—even at the height of his speed—having all four of his feet, at any portion of his stride, simultaneously free from contact with the ground (2).

Muybridge resolved to settle the controversy. It occurred to him that a series of photographic images made in rapid succession at predetermined intervals of time would answer the question. There were no motion pictures in 1872 and most still photographs were made on glass plates prepared by the photographer. Muybridge set up several banks of 12 to 24 stereoscopic cameras arranged parallel to the track on which the horse would trot at a predicted speed. When the horse reached position 1, which was opposite camera 1, Muybridge pressed a button that clicked the shutter of camera 1 and, by a "programmed" electric motor with 11 or 23 additional contacts, exposed successively, at the proper time, the photographic plates of cameras #2 to #12 or #2 to #24. A result is shown

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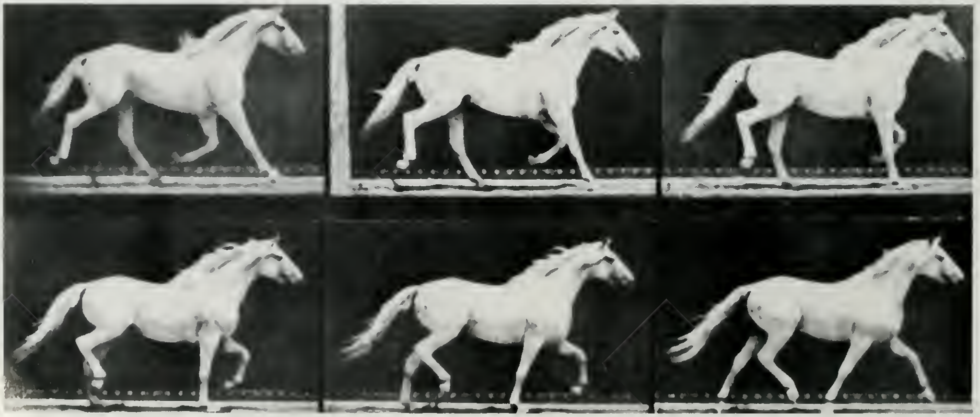
in the figure for 6 consecutive plates. Muybridge then mounted his glass plates on discs; when he rotated these, he had a very satisfactory reproduction of a miniature horse trotting along. (By mounting plates made by his stereoscopic cameras on 2 discs and rotating them at equal speeds, he could also produce 3-dimensional effects.) These apparently were the first motion pictures and, even if you don't believe that motion pictures produced in Hollywood or television studios represent an advance in civilization, motion pictures *have* been an invaluable tool in medicine and biology.

If Muybridge had written a grant application to NSF in 1872, some Congressmen would have vetoed it as frivolous. Fortunately, Leland Stanford provided an out-of-doors laboratory for Muybridge at his Palo Alto farm and later Provost William Pepper, along with trustees and friends of the University of Pennsylvania, raised funds for Muybridge to continue and publish his work on man, land animals, and birds in motion. In 1882, a French physiologists, Marey, improved Muybridge's multiple camera system by using a single camera, a strip of photographic film, and a succession of moving figures; in 1892 Edison used a moving strip and a lantern for projection, patented these, and became known as the "inventor" of motion pictures. Muybridge realized the role his moving pictures would play in the field of education and entertainment. In 1898, he wrote in the preface to his book: "The combination of such an instrument with the phonograph has not, at the time of writing, been satisfactorily accomplished; there can, however, be little doubt that in the—perhaps not far distant—future, instruments will be constructed that will not only reproduce visible actions simultaneously with audible words, but an entire opera, with the gestures, facial expressions and songs of the performers, with all the accompanying music, will be recorded … for the instruction or entertainment of an audience long after the original participants shall have passed away" (2).

In 1936, J. Z. Young, if he had been an American and there had been an NSF or NIH, might well have submitted a proposal to study nerve fibers in cephalopods, particularly in *Loligo* or squid (3). Since this is a creature that can suddenly move backward by jet propulsion of an ink-like material, some Congressmen could have had a field day likening scientists to squids—continuously moving backward while emitting large quantities of ink—and vetoed the project as irrelevant and ludicrous. In 1936, the justification written for Congress would not have predicted the impact of Young's study.

Because the squid contains giant nerve fibers up to 1 mm in diameter—50 to 1,000 times thicker than nerve fibers previously available for study—it permitted two crucial experiments: *(1)* one or more fine wire electrodes could be placed inside the nerve tube to permit scientists to measure the difference in electrical potential between the inside of the fiber and its outer surface; *(2)* the contents of the giant axone could be squeezed out, much as one rolls toothpaste from its tube, and the contents of the nerve cell and the amount of each could be measured precisely. This led to a revolution in neurophysiology and to electrophysiology in general. Electrophysiology includes electrocardiography; soon a micropipette was devised with a tip so small (0.0005 mm or less in diameter) that it could be put in heart muscle and into cells in each part of its special conducting system. Much of what we now know about the genesis of serious cardiac arrhythmias and how to evaluate proposed therapy has come from measurement of cardiac transmembrane potentials.

The studies of squid axones also led to a new science of active transport across cell membranes—how cells maintain quite different concentrations of salt inside compared to outside. Research on active transport has extended to many organ systems of the body; recently it has led to an understanding of the mechanism that causes secretion in the gastrointesti-



nal tract and permits patients with cholera to lose huge, even fatal, amounts of intestinal fluid secretions.

I can give more examples of projects that would evoke rude sounds from some Congressmen: (a) On the causes of the torpidity of the tenrec (4). (b) The effect of chemical substances on the rate of beating of cilia in oyster gills (5). (c) Sex attractants for insects (6). (d) Mechanism by which a bat in utter darkness catches a tiny insect flying at top speed (7).

(a) provided proof that even an animal living in the tropics could be made to hibernate in its winter months by relatively small decreases in body temperature and paved the way for hypothermia of patients during cardiac surgery.

(b) may serve as a test for blood-borne substances that inhibit ciliary activity in patients, such as those with cystic fibrosis.

(c) may well enable control of specific insect pests in certain areas without creating problems of air, water, or soil pollution.

(d) demonstrated the ultrasonic echolocation mechanism by which bats, flying in pitch-black caves, can catch prey but avoid other obstacles. It could have been the lead to sonar and radar in World War II, but Griffin's studies (7) were independent of radar and were not published until 1940, when radar had just been put to military use. Griffin asks, "Had biologists understood a few decades earlier the methods by which bats orient themselves, might not the invention of radar and sonar have come sooner? Or might we not already be in a position to perfect acoustic means for self guidance for the blind?... Granted that in this case the engineers anticipated the biologists, one may speculate whether this sequence is inevitable." I wonder how much Griffin's studies on echolocation in bats and birds hastened the development of the echocardiogram, a powerful new diagnostic tool in cardiology, developed in the 1950s.

I hope that scientists don't begin to submit research applications with phony titles just to escape Congressional scrutiny. Much good can come from congress taking a serious look at approved research grants. For when members of Congress question titles that seem "irrelevant," they may learn much about the nature of scientific discovery, and this may lead them to formulate, at last, a sound national policy for basic biomedical research. And an imaginative T. V. producer might read the Congressional Record and find it fascinating to educate the general public with a spell-binding series on "The Usefulness of the Absurd."

Wishful thinking? Not necessarily—some "absolutely impossible" things have happened in science!

Julius H. Comroe, Jr.

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Manuscript Preparation Guide

General Information

RESPIRATORY CARE welcomes original manuscripts related to the science and technology of respiratory care and prepared according to these Instructions and the *Uniform Requirements for Manuscripts Submitted to Biomedical Journals* [Respir Care 1997; 42(6):623-634]. Manuscripts are blinded and reviewed by professionals who are experts in their fields. Authors are responsible for all aspects of the manuscript and receive galleys to proofread before publication. Each accepted manuscript is copyedited so that its message is clear and it conforms to the Journal's style. Published papers are copyrighted by Daedalus Inc and may not be published elsewhere without permission.

Editorial consultation is available at any stage of planning or writing. On request, specific guidance is provided for all publication categories. To receive these Instructions and related materials, write to RESPIRATORY CARE, 600 Ninth Avenue, Suite 702, Seattle WA 98104, call (206) 223-0558, or fax (206) 223-0563.

Publication Categories & Structure

Research Article: A report of an original investigation (a study). It includes a Title Page, Abstract, Introduction, Methods, Results, Discussion, Conclusions, Product Sources, Acknowledgments, References, Tables, Appendices, Figures, and Figure Captions.

Evaluation of Device/Method/Technique: A description and evaluation of an old or new device, method, technique, or modification. It has a Title Page, Abstract, Introduction, Description of Device/Method/Technique, Evaluation Methods, Evaluation Results, Discussion, Conclusions, Product Sources, Acknowledgments, References, Tables, Appendices, Figures, and Figure Captions. Comparative cost data should be included wherever possible.

Case Report: A report of a clinical case that is uncommon, or was managed in a new way, or is exceptionally instructive. All authors must be associated with the case. A case-managing physician must either be an author or furnish a letter approving the manuscript. Its components are Title Page, Abstract, Introduction, Case Summary, Discussion, References, Tables, Figures, and Figure Captions.

Review Article: A comprehensive, critical review of the literature and state-of-the-art summary of a pertinent topic that has been the subject of at least 40 published research articles. Title Page, Outline, Introduction, Review of the Literature, Summary, Acknowledgments, References. Tables, Appendices, and Figures and Captions may be included.

Overview: A critical review of a pertinent topic that has fewer than 40 published research articles.

Update: A report of subsequent developments in a topic that has been critically reviewed in this Journal or elsewhere.

Point-of-View Paper: A paper expressing personal but substantiated opinions on a pertinent topic. Title Page, Text, References, Tables, and Illustrations may be included.

Special Article: A pertinent paper not fitting one of the foregoing categories may be acceptable as a Special Article. Consult with the Editor before writing or submitting such a paper.

Editorial: A paper drawing attention to a pertinent concern; it may present an opposing opinion, clarify a position, or bring a problem into focus.

Letter: A signed communication, marked "For publication," about prior publications in this Journal or about other pertinent topics. Tables and illustrations may be included.

Blood Gas Corner: A brief, instructive case report involving blood gas values—with Questions, Answers, and Discussion.

Drug Capsule: A mini-review paper about a drug or class of drugs that includes discussions of pharmacology, pharmacokinetics, and pharmacotherapy.

Graphics Corner: A brief case report incorporating waveforms for monitoring or diagnosis—with Questions, Answers, and Discussion.

Kittredge's Corner: A brief description of the operation of respiratory care equipment—with information from manufacturers and editorial comments and suggestions.

PFT Corner: Like Blood Gas Corner, but involving pulmonary function tests.

Cardiorespiratory Interactions. A case report demonstrating the interaction between the cardiovascular and respiratory systems. It should be a patient-care scenario; however, the case—the central theme—is the systems interaction. CRI is characterized by figures, equations, and a glossary. See the March 1996 Issue of RESPIRATORY CARE for more detail.

Test Your Radiologic Skill: Like Blood Gas Corner, but involving pulmonary medicine radiography and including one or more radiographs; may involve imaging techniques other than conventional chest radiography.

Review of Book, Film, Tape, or Software: A balanced, critical review of a recent release.

Preparing the Manuscript

Print on one side of white bond paper, 8.5 in. x 11 in. (216 x 279 mm) with margins of at least 1 in. (25 mm) on all sides of the page. Use ***double-spacing*** throughout the ***entire*** manuscript. Use a standard font (eg, Times, Helvetica, or Courier) at least 10 points in size, and do not use italics except for special emphasis. Number all pages in upper-right corners. Indent paragraphs 5 spaces. Do ***not justify***. **Do *not* put authors' names, institutional affiliations or allusions to institutional affiliations in the text, or other identification anywhere except on the title page.** Repeat title only (no authors) on the abstract page. Begin each of the following on a new page: Title Page, Abstract, Text, Product Sources List, Acknowledgments, References, each Table, and each Appendix. Use standard English in the first person and active voice.

Center main section headings on the page and type them in capital and small letters (eg, Introduction, Methods, Results, Discussion). Begin subheadings at the left margin and type them in capital and small letters (eg, Patients, Equipment, Statistical Analysis).

References. Cite only published works as references. Manuscripts accepted but not yet published may be cited as references: designate the accepting journal, followed by (in press), and provide 3 copies of the in-press article for reviewer inspection. Cite references in the text with superscript numerals. Assign numbers in the order that references are first cited. On the reference page, list the cited works in numerical order. Follow the Journal's style for references. Abbreviate journal names as in *Index Medicus*. List all authors.

Article in a journal carrying pagination throughout volume:

> Rau JL, Harwood RJ. Comparison of nebulizer delivery methods through a neonatal endotracheal tube: a bench study. Respir Care 1992;37(11):1233-1240.

Article in a publication that numbers each issue beginning with Page 1:

> Bunch D. Establishing a national database for home care. AARC Times 1991;15(Mar):61,62,64.

Corporate author journal article:

> American Association for Respiratory Care. Criteria for establishing units for chronic ventilator-dependent patients in hospitals. Respir Care 1988;33(11):1044-1046.

Article in journal supplement: (Journals differ in their methods of numbering and identifying supplements. Supply sufficient information to promote retrieval.)

> Reynolds HY. Idiopathic interstitial pulmonary fibrosis. Chest 1986; 89(3 Suppl):139S-143S.

Abstract in journal: (Abstracts citations are to be avoided. Those more than 3 years old should not be cited.)

> Stevens DP. Scavenging ribavirin from an oxygen hood to reduce environmental exposure (abstract). Respir Care 1990;35(11): 1087-1088.

Editorial in journal:

> Enright P. Can we relax during spirometry? (editorial). Am Rev Respir Dis 1993;148(2):274.

Editorial with no author given:

> Negative-pressure ventilation for chronic obstructive pulmonary disease (editorial). Lancet 1992;340(8833):1440-1441.

Letter in journal:

> Aelony Y. Ethnic norms for pulmonary function tests (letter). Chest 1991;99(4):1051.

Paper accepted but not yet published:

> Hess D. New therapies for asthma. Respir Care (year, in press).

Personal author book: (For any book, specific pages should be cited whenever possible.)

> DeRemee RA. Clinical profiles of diffuse interstitial pulmonary disease. New York: Futura; 1990. p. 76-85.

Corporate author book:

> American Medical Association Department of Drugs. AMA drug evaluations, 3rd ed. Littleton CO: Publishing Sciences Group; 1977.

Chapter in book with editor(s):

> Pierce AK. Acute respiratory failure. In: Guenter CA, Welch MH, editors. Pulmonary medicine. Philadelphia: JB Lippincott; 1977:26-42.

Tables. Use consecutively numbered tables to display information. Start each table on a separate page. Number and title the table and give each column a brief heading. Place explanations in footnotes, including all nonstandard abbreviations and symbols. Key the footnotes with conventional designations (*, †, ‡, §, ||, ¶, **, ††) in consistent order, placing them superscript in the table body. Do not use horizontal or vertical rules or borders. Do not submit tables as photographs, reduced in size, or on oversize paper. Use the same typeface as in the text.

Illustrations. Graphs, line drawings, photographs, and radiographs are figures. Use only illustrations that clarify and augment the text. Number them consecutively as Fig. 1, Fig. 2, and so forth according to the order by which they are mentioned in the text. Be sure all figures are cited. If any figure was previously published, include copyright holder's written permission to reproduce. Figures for publication must be of professional quality. Data for the original graphs should be available to the Editor upon request. If color is essential, consult the Editor for more information. In reports of animal experiments, use schematic drawings, not photographs. A letter of consent must accompany any photograph of a person. Do not place titles and detailed explanations on figures; put this information in figure captions. If possible, submit radiographs as prints and full-size copies of film.

Drugs. Identify precisely all drugs and chemicals used, giving generic names, doses, and routes of administration. If desired, brand names may be given in parentheses after generic names. Drugs should be listed on the product-sources page.

Commercial Products. In parentheses in the text, identify any commercial product (including model number if applicable) the first time it is mentioned, giving the manufacturer's name, city, and state or country. If four or more products are mentioned, do not list any manufacturers in the text; instead, list them on a Product Sources page at the end of the text, before the References. Provide model numbers when available and manufacturer's suggested price, if the study has cost implications.

Ethics. When reporting experiments on human subjects, indicate that procedures were conducted in accordance with the ethical standards of the *World Medical Association Declaration of Helsinki* [Respir Care 1997;42(6):635-636] or of the institution's committee on human experimentation. State that informed consent was obtained. Do not use patient's names, initials, or hospital numbers in text or illustrations. When reporting experiments on animals, indicate that the institution's policy, a national guideline, or a law on the care and use of laboratory animals was followed.

Statistics. Identify the statistical tests used in analyzing the data, and give the prospectively determined level of significance in the Methods section. Report actual p values in Results. Cite only textbook and published article references to support choices of tests. Identify any general-use or commercial computer programs used, naming manufacturers and their locations. These should be listed on the product-sources page.

Units of Measurement. Express measurements of length, height, weight, and volume in metric units appropriately abbreviated; temperatures in degrees Celsius; and blood pressures in millimeters of mercury (mm Hg). Report hematologic and clinical-chemistry measurements in conventional metric and in SI (*Systémé Internationale*) units. Show gas pressures (including blood gas tensions) in torr. List SI equivalent values, when possible, in brackets following non-SI values—for example, "PEEP, 10 cm H_2O [0.981 kPa]." For conversion to SI, see RESPIRATORY CARE 1988;33(10):861-873 (Oct 1988), 1989;34(2):145 (Feb 1989), and 1997;42(6):639-640 (June 1997).

Conflict of Interest. Authors are asked to disclose any liaison or financial arrangement they have with a manufacturer or distributor whose product is part of the submitted manuscript or with the manufacturer or distributor of a competing product. (Such arrangements do not disqualify a paper from consideration and are not disclosed to reviewers.) A statement to this effect is included on the cover-letter page. (Reviewers are screened for possible conflict of interest.)

Abbreviations and Symbols. Use standard abbreviations and symbols. Avoid creating new abbreviations. Avoid all abbreviations in the title and unusual abbreviations in the abstract. Use an abbreviation only if the term occurs several times in the paper. Write out the full term the first time it appears, followed by the abbreviation in parentheses. Thereafter, employ the abbreviation alone. Never use an abbreviation without defining it. Standard units of measurement can be abbreviated without explanation (eg, 10 L/min, 15 torr, 2.3 kPa).

Please use the following forms: cm H_2O (not cmH2O), f (not bpm), L (not l), L/min (not LPM, l/min, or lpm), mL (not ml), mm Hg (not mmHg), pH (not Ph or PH), $p > 0.001$ (not p>0.001), s (not sec), S_{pO_2} (pulse-oximetry saturation). See RESPIRATORY CARE: Standard Abbreviations and Symbols [Respir Care 1997;42(6):637-642].

Submitting the Manuscript

Mail three copies [1 copy with author(s) name(s), affiliation(s), 2 copies without name(s) and affiliation(s) for reviewers] of the manuscript, figures, and 1 diskette, and the Cover Letter & Checklist to RESPIRATORY CARE, 600 Ninth Avenue, Suite 702, Seattle WA 98104. Do not fax manuscripts. Protect figures with cardboard. Keep a copy of the manuscript and figures. Receipt of your manuscript will be acknowledged.

Computer Diskettes. Authors are encouraged to submit electronic versions of manuscripts as well as printed copies (3.5 in. diskettes in Macintosh or IBM-DOS format). Label each diskette with date; author's name; name and version of word-processing program used; and filename(s). Software used to produce graphics and tables should be similarly identified. Do not write on diskette labels except with felt-tipped pen. If revision of a manuscript is required as a condition of acceptance for publication, we ask that an electronic version of revision be supplied to facilitate copyediting and production.

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☐ Has the manuscript been proofread by all the authors?
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MEDWATCH

THE FDA MEDICAL PRODUCTS REPORTING PROGRAM

For VOLUNTARY reporting
by health professionals of adverse
events and product problems

Page ____ of ____

Form Approved OMB No 0910-0291 Expires 4/30/96
See OMB statement on reverse

FDA Use Only (Resp Care)

Triage unit
sequence #

A. Patient information

1. **Patient identifier** In confidence
2. **Age at time of event:** ____ or **Date of birth:**
3. **Sex** ☐ female ☐ male
4. **Weight** ____ lbs or ____ kgs

B. Adverse event or product problem

1. ☐ **Adverse event** and/or ☐ **Product problem** (e.g . defects/malfunctions)

2. **Outcomes attributed to adverse event** (check all that apply)

- ☐ death ____ (mo/day/yr)
- ☐ life-threatening
- ☐ hospitalization – initial or prolonged
- ☐ disability
- ☐ congenital anomaly
- ☐ required intervention to prevent permanent impairment/damage
- ☐ other: ____

3. **Date of event** (mo/day/yr)

4. **Date of this report** (mo/day/yr)

5. **Describe event or problem**

6. **Relevant tests/laboratory data,** including dates

7. **Other relevant history, including preexisting medical conditions** (e.g., allergies, race, pregnancy, smoking and alcohol use, hepatic/renal dysfunction, etc.)

C. Suspect medication(s)

1. **Name** (give labeled strength & mfr/labeler, if known)

#1 ____

#2

2. **Dose, frequency & route used**

#1 ____

#2

3. **Therapy dates** (if unknown, give duration) (from/to (or best estimate))

#1 ____

#2

4. **Diagnosis for use** (indication)

#1 ____

#2

5. **Event abated after use stopped or dose reduced**

#1 ☐ yes ☐ no ☐ doesn't apply

#2 ☐ yes ☐ no ☐ doesn't apply

6. **Lot #** (if known)

#1 ____

#2

7. **Exp. date** (if known)

#1 ____

#2

8. **Event reappeared after reintroduction**

#1 ☐ yes ☐ no ☐ doesn't apply

#2 ☐ yes ☐ no ☐ doesn't apply

9. **NDC #** (for product problems only)

– –

10. **Concomitant medical products** and therapy dates (exclude treatment of event)

D. Suspect medical device

1. **Brand name**

2. **Type of device**

3. **Manufacturer name & address**

4. **Operator of device**

- ☐ health professional
- ☐ lay user/patient
- ☐ other: ____

5. **Expiration date** (mo/day/yr)

6.

model # ____

catalog # ____

serial # ____

lot # ____

other #

7. **If implanted, give date** (mo/day/yr)

8. **If explanted, give date** (mo/day/yr)

9. **Device available for evaluation?** (Do not send to FDA)

☐ yes ☐ no ☐ returned to manufacturer on ____ (mo/day/yr)

10. **Concomitant medical products** and therapy dates (exclude treatment of event)

E. Reporter (see confidentiality section on back)

1. **Name & address** **phone #**

2. **Health professional?** ☐ yes ☐ no

3. **Occupation**

4. **Also reported to**

- ☐ manufacturer
- ☐ user facility
- ☐ distributor

5. If you do NOT want your identity disclosed to the manufacturer, place an " X " in this box. ☐

FDA

Mail to: MEDWATCH
5600 Fishers Lane
Rockville, MD 20852-9787

or FAX to:
1-800-FDA-0178

DA Form 3500 1/96)

Submission of a report does not constitute an admission that medical personnel or the product caused or contributed to the event.

ADVICE ABOUT VOLUNTARY REPORTING

Report experiences with:

- medications (drugs or biologics)
- medical devices (including in-vitro diagnostics)
- special nutritional products (dietary supplements, medical foods, infant formulas)
- other products regulated by FDA

Report SERIOUS adverse events. An event is serious when the patient outcome is:

- death
- life-threatening (real risk of dying)
- hospitalization (initial or prolonged)
- disability (significant, persistent or permanent)
- congenital anomaly
- required intervention to prevent permanent impairment or damage

Report even if:

- you're not certain the product caused the event
- you don't have all the details

Report product problems – quality, performance or safety concerns such as:

- suspected contamination
- questionable stability
- defective components
- poor packaging or labeling
- therapeutic failures

How to report:

- just fill in the sections that apply to your report
- use section C for all products except medical devices
- attach additional blank pages if needed
- use a separate form for each patient
- report either to FDA or the manufacturer (or both)

Important numbers:

• 1-800-FDA-0178	to FAX report
• 1-800-FDA-7737	to report by modem
• 1-800-FDA-1088	to report by phone or for more information
• 1-800-822-7967	for a VAERS form for vaccines

If your report involves a serious adverse event with a device and it occurred in a facility outside a doctor's office, that facility may be legally required to report to FDA and/or the manufacturer. Please notify the person in that facility who would handle such reporting.

Confidentiality: The patient's identity is held in strict confidence by FDA and protected to the fullest extent of the law. The reporter's identity, including the identity of a self-reporter, may be shared with the manufacturer unless requested otherwise. However, FDA will not disclose the reporter's identity in response to a request from the public, pursuant to the Freedom of Information Act.

The public reporting burden for this collection of information has been estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to:

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Hubert H. Humphrey Building, Room 531-H
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Washington, DC 20201

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Public Health Service • Food and Drug Administration

FDA Form 3500-back

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MEDWATCH

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Food and Drug Administration
5600 Fishers Lane
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1998 Call for Abstracts

RESPIRATORY CARE • OPEN FORUM

The American Association for Respiratory Care and its science journal, RESPIRATORY CARE, invite submission of brief abstracts related to any aspect of cardiorespiratory care. The abstracts will be reviewed, and selected authors will be invited to present posters at the OPEN FORUM during the AARC International Respiratory Congress in Atlanta, Georgia, November 7–10, 1998. Accepted abstracts will be published in the October 1998 issue of RESPIRATORY CARE. Membership in the AARC is not required for participation. All accepted abstracts are automatically considered for ARCF research grants.

SPECIFICATIONS—READ CAREFULLY!

An abstract may report **(1) an original study, (2) the evaluation of a method, device or protocol, or (3) a case or case series.** Topics may be aspects of adult acute care, continuing care/rehabilitation, perinatology/pediatrics, cardiopulmonary technology, or health care delivery. The abstract may have been presented previously at a local or regional—but not national—meeting and should not have been published previously in a national journal. The abstract is the only evidence by which the reviewers can decide whether the author should be invited to present a poster at the OPEN FORUM. Therefore, *the abstract must provide all important data, findings, and conclusions.* Give specific information. Do not write such general statements as "Results will be presented" or "Significance will be discussed."

Essential Content Elements

Original study. Abstract *must* include (1) Background: statement of research problem, question, or hypothesis; (2) Method: description of research design and conduct in sufficient detail to permit judgment of validity; (3) Results: statement of research findings with quantitative data and statistical analysis; (4) Conclusions: interpretation of the meaning of the results.

Method, device, or protocol evaluation. Abstract *must* include (1) Background: identification of the method, device, or protocol and its intended function; (2) Method: description of the evaluation in sufficient detail to permit judgment of its objectivity and validity; (3) Results: findings of the evaluation; (4) Experience: summary of the author's practical experience or a lack of experience; (5) Conclusions: interpretation of the evaluation and experience. Cost comparisons should be included where possible and appropriate.

Case report. Abstract *must* report a case that is uncommon or of exceptional educational value and must include (1) Introduction: Relevant basic information important to understanding the case. (2) Case Summary: Patient data and response, details of interventions. (3) Discussion: Content should reflect results of literature review. The author(s) should have been actively involved in the case and a case-managing physician must be a co-author or must approve the report.

Abstract Format and Typing Instructions

Accepted abstracts will be photographed and reduced by 40%; therefore, the size of the original text should be *at least* 10 points. A font like Helvetica or Geneva makes the clearest reproduction. The first line of the abstract should be the title in all capital letters. Title should explain content. Follow title with names of all authors (including credentials), institution(s), and location; underline presenter's name. Type or electronically print the abstract *single spaced in a single paragraph in the space provided on the abstract blank.* Insert only one letter space between sentences. Text submission on diskette is encouraged but must be accompanied by a hard copy. Identifiers will be masked (blinded) for review. Data may be submitted in table form, *and simple figures may be included provided they fit within the space allotted.* No figures, illustrations, or tables are to be attached to the abstract form. Provide all author information requested. A clear photocopy of the abstract form may be used. Standard abbreviations may be employed without explanation; new or infrequently used abbreviations should be spelled out on first use. Any recurring phrase or expression may be abbreviated, if it is first explained. Check the abstract for (1) errors in spelling, grammar, facts, and figures; (2) clarity of language; and (3) conformance to these specifications. An abstract not prepared as requested may not be reviewed. Questions about abstract preparation may be telephoned to the editorial staff of RESPIRATORY CARE at (972) 406-4667.

Deadline Allowing Revision

Authors may choose to submit abstracts early. Abstracts postmarked by February 16, 1998 will be reviewed and the authors notified *by letter only* to be mailed by March 20, 1998. Rejected abstracts will be accompanied by a written critique that should, in many cases, enable authors to revise their abstracts and resubmit them by the final deadline (May 4, 1998).

Final Deadline

The mandatory Final Deadline is May 4, 1998 (postmark). Authors will be notified of acceptance or rejection *by letter only.* These letters will be mailed by July 20, 1998.

Mailing Instructions

Mail (Do not fax!) 2 clear copies of the completed abstract form, diskette (if possible), and a stamped, self-addressed postcard (for notice of receipt) to:

RESPIRATORY CARE OPEN FORUM
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Dallas TX 75229-4593

1998 RESPIRATORY CARE OPEN FORUM

Abstract Form

18.8 cm or 7.4"

13.9 cm or 5.5"

1. Title must be in all upper case (capital) letters, authors' full names and text in upper and lower case.
2. Follow title with all authors' names including credentials (underline presenter's name), institution, and location.
3. Do not justify (ie, leave a 'ragged' right margin).
4. **Do not use type size less than 10 points.**
5. All text, tables, and figures must fit into the rectangle shown.
6. Submit 2 clean copies. This form may be photocopied if multiple abstracts are to be submitted.

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Early deadline is
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(postmark)

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May 4, 1998
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News releases about new products and services will be considered for publication in this section. There is no charge for these listings. Send descriptive release and glossy black and white photographs to RESPIRATORY CARE Journal, New Products and Services Dept, 11030 Ables Lane, Dallas TX 75229-4593. The Reader Service Card immediately follows the authors & advertisers index at the back of the Journal.

New Products & Services

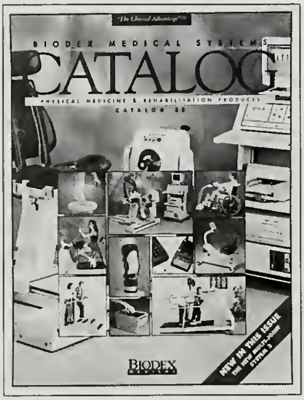
PULSE OXIMETER. Nellcor Puritan Bennett releases the NPB-190 Pulse Oximeter. The manufacturer calls the unit an affordable, accurate, and reliable solution for oxygen saturation monitoring with benefits such as convenient transport and ease of use. Additional features include an internal power supply, EIA-232 and ASCII data outputs, and nurse call capability. The NPB-190 is also equipped with audible and visible alarms for high-low saturation and pulse rate, an indicator for pulse search, and an adjustable alarm silence duration. Circle Reader Service Number 160 for more information.

IMPROVED PEAK FLOW METER. HealthScan Products Inc introduces the ASSESS® peak flow meter with the Asthma Management Zone System. Zone clips can be attached to the right side of ASSESS and positioned at appropriate scale locations to indicate personal safety, caution, and danger peak flows. Patients can determine the status of their peak flows by locating their reading within the bands of color, which are analogous to a traffic light's green, yellow, and red signals, according to the manufacturer. A 4-zone system that divides the yellow zone into high yellow and low yellow is also available. Circle Reader Service Number 161 for details from Healthscan.

RESEARCH DESIGN SOFTWARE. Scolari, Sage Publications Software distributes Methodologist's Toolchest,™ a CD-ROM suite that helps with research design and presentation. Designed to replace costly consultants, several time-saving features plus a user-friendly interface contribute to the wide appeal and value of the software utilities, according to the publisher. Each of the 9 modules is devoted to specific tasks, such as research planning, funding, data collection, and statistical analysis. Also included are a peer-review emulator and a data-graphing utility, and a cross-referenced online dictionary with hypertext links. To find out more about Methodologist's Toolchest,™ circle Reader Service Number 162.

COMPACT COMPRESSOR. Precision Medical Inc introduces the Easy/Air 15 high-flow compressor. The compact, lightweight unit is suited for use in situations where space and convenient transport are concerns, such as home and long-term care facilities. Internal and external filters can be cleaned and reused because both are located on the exterior of the cabinet. A company news bulletin mentions other unique features such as a built-in flow gauge, an elapsed time indicator, an internal delay circuit breaker, plus sound absorption foam for quiet operation. For more information, circle Reader Service Number 163.

BREATH-ACTUATED INHALER. 3M Pharmaceuticals presents the Maxair™ Autohaler™ as an alternative to conventional metered dose inhalers (MDIs). Maxair™ contains pirbuterol acetate, a short-acting β agonist similar to other typical inhaled drugs. The automatic inhaler was developed for asthma patients who may not be getting the full benefit of inhaled medication from conventional MDIs. Without requiring a spacer, the breath-actuated inhaler releases medication automatically as the patient inhales on the mouthpiece. According to 3M, this eliminates the need for coordinated pressing and breathing by the patient. For more information from the manufacturer about the medication, indications, contraindications, and side effects, circle Reader Service Number 164.



REHABILITATION PRODUCTS CATALOG. From Biodex Medical, the new Physical Medicine and Rehabilitation Products Catalog features more than 300 products designed to return patients to functional outcomes. Included in its 90 pages are several new sections: Exercise and Stretching Therapy, Hot and Cold Therapy, Orthopedic Supports and Products, and Pre-Owned Equipment. Each item is backed by a full warranty from Biodex. For a free copy of the catalog, circle number 165 on the Reader Service Card.

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February 10

Indications-Safety Considerations-Side Effects
Prof: Mark W. Millard, MD
Host: Gretchen Lawrence, BA, RRT

This program will review the pharmacology section of the revised NAEPP guidelines. Additionally, the potential hazards and undesirable side effects of commonly prescribed medications will be discussed, with alternative treatment regimens suggested.

The "Professor's Rounds" Teleconferences Are 90 Minutes of Training Designed to Bring Respiratory Therapists Out of the Dark and Into the Growing Field of Healthcare

These teleconferences are available in video and audio formats. The *Video* teleconference is a live, 90-minute interactive video program delivered by satellite. The *Audio* teleconference consists of a 90-minute videotaped presentation and a live 30-minute telephone question and answer session (available March 17).

Don't find yourself lost in the dark on important issues that involve your career. Be a leader in healthcare and move at a pace that will enlighten others in the respiratory field. The 90-minute sessions are designed to educate and answer the many questions lingering in respiratory therapists minds. Examples of topics covered are technology, restructuring, reform and regulations.

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Calendar of Events

AARC & AFFILIATES

February 4-6, 1998—Oregon Society
Annual Pacific Northwest Respiratory Care Conference at the Valley River Inn in Eugene, Oregon. Events include a manager's breakfast featuring AARC Executive Director Sam Giordano.
Contact: Irene Iwata-Morgan at (503) 494-6158

February 5-8, 1998—Clinical Laboratory Management Association
The Second Annual Congress on Integrated Health Care Management at the Dallas Lakes Hilton, Dallas, Texas. Last year's Congress was highlighted in the March issue of *AARC Times*.
Contact: CLMA at (610) 995-9580 or (202) 543-7971.

OTHER MEETINGS

February 4-8, 1998—Society of Critical Care Medicine
27th Annual Educational & Scientific Symposium at the convention center, San Antonio, Texas.
Contact: Call (714) 282-6000, fax (714) 282-6050, or visit their web site at www.sccm.org.

February 8-11, 1998—The American College of Chest Physicians
Cardiopulmonary Wellness and Rehabilitation meeting in Breckenridge, Colorado.
Contact: Arlene Karavich at (847) 498-1400 or fax (847) 498-5460.

February 10-13, 1998—American Lung Association of Nevada
The 17th annual High Sierra Critical Care Conference at the Reno Convention Center, Reno, Nevada.
Contact: (702) 829-5864 or fax (702) 829-5850.

March 1-5, 1998—Children's National Medical Center
The 14th annual symposium, "ECMO and Advanced Therapies for Respiratory Failure" will be held in Keystone, Colorado. Registration deadline is Jan 8, 1998.
Contact: Cynthia Poindexter at (202) 884-5018.

April 9-10, 1998—InfoCare
The Annual Adult Respiratory/Critical Care Symposium will be hosted at the Sheraton Fiesta Beach Resort, South Padre Island, Texas.
Contact: (956) 233-5645 or fax (956) 233-1010.

May 8-10, 1998—Medical University of South Carolina ECMO Service
The 8th annual Southeastern ECMO Conference at the Frances Marion Hotel, Charleston, South Carolina.
Contact: Sandra Ballard at (803) 792-9941.

August 3-7, 1998—American Society of Electroneurodiagnostic Technologists and the Association of Polysomnographic Technologists
39th Annual Convention will be held at the Sheraton Hotel, New Orleans, Louisiana.
Contact: ASET executive office at (712) 792-2978, fax (712) 792-6962, e-mail aset@netins.net or visit their web site at www.aset.org.

August 27-28, 1998—Cleveland Clinic Foundation
Horizons in Pulmonary & Critical Care Medicine to be held at the Cleveland Clinic's Bunts Auditorium, Cleveland, Ohio.
CRCE: Has been approved for Category 1 accreditation.
Contact: Call (800) 762-8173, (216) 444-5695, or fax (216) 445-9406.

Notices

Notices of competitions, scholarships, fellowships, examination dates, new educational programs, and the like will be listed here free of charge. Items for the Notices section must reach the Journal 60 days before the desired month of publication (January 1 for the March issue, February 1 for the April issue, etc). Include all pertinent information and mail notices to RESPIRATORY CARE Notices Dept, 11030 Ables Lane, Dallas TX 75229-4593.

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The Dallas Editorial Office will track all manuscripts submitted prior to November 1, 1997. Questions may be directed to: Kris Williams, *Assistant Editor*, (e-mail: williams@aarc.org, or Linda Barcus, *Editorial Assistant*, (e-mail: barcus@aarc.org).

Helpful Web Sites

American Association for Respiratory Care
http://www.aarc.org
Free access to MEDLINE is now available on our web site

National Board for Respiratory Care
http://www.nbrc.org

Applied Measurement Professionals Inc
http://www.applmeapro.com

The American Academy of Pediatrics
http://www.aap.org

Extracorporeal Life Support Organization
http://www.med.umich.edu/elso/

U.S. Department of Health and Human Services, Health Advice
http://www.healthfinder.gov

Food and Drug Administration
http://www.fda.gov

National Asthma Education Prevention Program Guidelines, 2nd Edition
http://www.nhlbi.nih.gov/nhlbi/lung/asthma/prof/asthgdln.htm

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The National Board for Respiratory Care—1998 Examination Dates and Fees

Examination	Examination Date	Examination Fee	
CRTT Examination	July 11, 1998	$ 100	(new applicant)*
	Application Deadline: May 1, 1998	60	(reapplicant)*
	November 14, 1998	100	(new applicant)*
	Application Deadline: September 1, 1998	60	(reapplicant)*
RRT Examination	June 6, 1998	120	Written only (new applicant)
	Application Deadline: February 1, 1998	80	Written only (reapplicant)
		130	CSE only (all applicants)
	December 5, 1998	250	Both (new applicant)
	Application Deadline: August 1, 1998	210	Both (reapplicant)
CPFT Examination	June 6, 1998	130	(new applicant)
	Application Deadline: April 1, 1998	100	(reapplicant)
RPFT Examination	December 5, 1998	180	(new applicant)
	Application Deadline. September 1, 1997	150	(reapplicant)
Perinatal/Pediatric Respiratory Care Specialty Examination	March 14, 1998	180	(new applicant)
	Application Deadline: November 1, 1998	150	(reapplicant)

*In 1999, this examination fee will increase by $20.

For information about other services or fees, write to the National Board for Respiratory Care, 8310 Nieman Road, Lenexa KS 66214, or call (913) 599-4200, FAX (913) 541-0156,or e-mail: nbrc-info@nbrc.org

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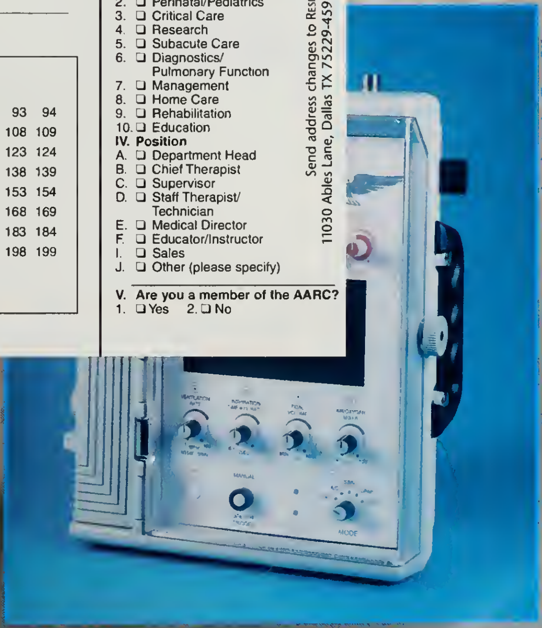

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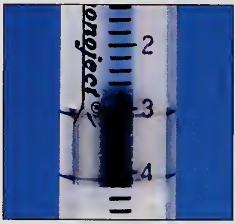

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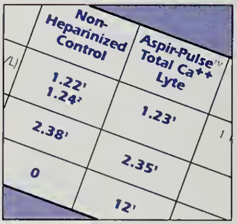

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